The Academic and the Everyday: Subject Advisors' and Teachers' Interpretations and Classroom Practices Related to the Goal of Connecting School Mathematics and Students' Everyday Experiences in Namibia

Vatileni, Frieda Ndemupomhito

Awarding institution:
King's College London

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By

Frieda N Hakadiva-Vatileni

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King's College London

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ABSTRACT

In assuming that relating school mathematics to students' everyday out-of-school practices and other related experiences is beneficial to the learning and appreciation of the usefulness of mathematics, there have been widespread calls for realising a school mathematics curriculum that makes mathematics meaningful for learners. In Namibia, for instance, the mathematics curriculum for Upper Primary and Junior Secondary suggests that by application and local contextualisation of mathematics, this goal can be achieved. However, teachers' pedagogic approaches to put these aspirations into practice remain under-researched. This makes this subject worthwhile to investigate further. The aim of this study was therefore to investigate how teachers and personnel with curricular responsibility interpret the official goal statement of the curriculum and how teachers realise their interpretations in classroom practice. Methodologically, the study used interviews with subject advisors and teachers, and observations of classroom teaching by means of video. Theoretically, the research draws on studies of recontextualisation. The findings suggest that (i) the sense subject advisors and teachers make of the curriculum declamatory statement promoting meaningful mathematics is divergent, (ii) teachers' practices that attempt to bridge school mathematics and the everyday are ad hoc and not uniform, and (ii) general curriculum statements are rarely taken into consideration as far as the planning of teaching is concerned. This fed back not only to knowledge and understanding of mathematics classroom practice, but the analysis of classroom video data showed the complexity of the teachers' work and pointed to the fruitfulness of an analysis that works on a linguistic level for capturing modes of 'bridging school mathematics and the everyday', including unintended consequences of attempts that might be classified as unsuccessful.

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List of Abbreviations and Acronyms

CDS	Curriculum Declamatory Statement
DAS	Domains of Actions Scheme
DNEA	Directorate of National Examination and Assessment
E&M REP	Education and Management Research Ethics Panel
EO	Education Officer
LCE	Learner-Centred Education
NCTM	National Council of Teachers of Mathematics
NIED	National Institute for Educational Development
OPD	Official Pedagogic Discourse
ORF	Official Recontextualisation Field
PD	Pedagogic Device
PQA	Programme and Quality Assurance
PRF	Pedagogic Recontextualisation Field
RESC	Research Ethics Subcommittee
REP	Research Ethics Panel
SA	Subject Advisor
SAM	Social Activity Method
SES	Socio-Economic Status
SSPP	School of Social Science and Public Policy
TDT	Theory of Didactic Transposition

PART I

1 Background, motivation and research setting

This study is concerned with mathematics education in Namibia, a country whose education policy has changed dramatically since the country's independence in 1990. Mathematics education for all has become an important goal in order to overcome restrictions of access to quality academic education based on racial classification. While the research question for this study is framed with reference to the particular context of the Namibian education system, the discourse of making mathematics more relevant, meaningful and motivating by connecting school mathematics to students' everyday experiences is international. Ideas emanating from this discourse, as well as many other ideas, have entered Namibia through South Africa and via the policy of learner-centred teaching (Kasanda et al., 2005). Learner-centred education (LCE) is a foundation policy for the new education system which was introduced in Namibia soon after independence in 1991 (National Institute for Educational Development [NIED], 2003).

This chapter provides a reflection of professional experience that motivated the undertaking and a short outline of the context of this research study. It also includes an introduction to Namibia's education system and policy. The managerial structure within which mathematics as a school subject is organised in Namibia is of particular interest for the study and includes actors from different system levels (subject advisors and teachers). This information is intended to provide sufficient background for the research questions asked. The section that follows deals more specifically with the national curriculum and the official document that motivated the research questions.

1.1 Personal motivation

"Research is a personal venture, which quite aside from its social benefits, is worth doing for its direct contribution to one's own self-realization" (Bullough & Pinnegar, 2001, p. 13). This statement reflects very well part of the researcher's relationship with the topic of this study. Initially, the researcher's research interest in the topic arose during the early years of the researcher's career as a mathematics teacher at a Senior Secondary School. There were times when she struggled to explain and represent some of the mathematics concepts to her students. Among others, she remembers struggling to explain the mathematics concept of *undefined* (for example, the idea of dividing any quantity by zero). Further, even though she knew how to solve integration and differentiation problems in calculus, she found it difficult to tell her students why it is necessary to learn those topics. These were some of the pedagogical issues which either held back or obstructed the researcher's teaching practice.

Another motivation arose from the curriculum statement printed in the mathematics syllabus for both Upper Primary and Junior Secondary mathematics. The statement reads, "*Mathematics is a universal language. It is only by local contextualisation and application that younger learners will understand and appreciate the uses of mathematics*. *Where textbooks can only give general examples, it is up to the teacher to use and include local examples by developing appropriate worksheets and exercises".* This statement suggested to the researcher an approach to teaching and learning mathematics. The researcher's reading was that in cases where textbooks only gave general examples, it should be the teacher's responsibility to design, develop, and use appropriate materials and worksheets. In this manner, the statement seemed to have made it categorically clear what the mathematics teacher is expected to do in a classroom. The mathematics teacher should consider the context and should incorporate the local culture and practice. Since the statement declares what mathematics teachers ought to do in their classroom, it makes this pedagogy a public issue and also an issue open to empirical research.

However, when coming across the statement, the researcher wondered what exactly is meant by "Mathematics is a universal language". Likewise, she had only a vague idea of what its authors may have intended by using the term *contextualisation;* neither was it clear what they meant by *application*. Also, the word *local* could be interpreted in different ways. Apart from the researcher's own struggles, she also wondered how other school mathematics teachers made sense of this statement and its terminology, as well as how they realised their interpretations in their own practices in the mathematics classroom.

Even though the researcher had only a hazy idea about what the curriculum authors could have intended, she believed that incorporating the everyday into the mathematics classroom is a simple and straightforward undertaking; this is probably a feeling that is shared by a number of mathematics teachers. She never realised, however, that this is a process with pitfalls and tensions.

Though the aforementioned were the researcher's problems, this does not constitute them as only the researcher's personal problems. Mills (1959) argued, *personal troubles cannot be solved merely as troubles, but must be understood in terms of public issues, and that human meaning of public issues must be revealed by relating them to personal troubles and to the problems of the individual life. (p. 226)*

The researcher felt that there is a need to study mathematics teaching practice, particularly how teachers incorporate the everyday and the manner in which they facilitate "border crossing" between the everyday world and the world of mathematics. Studies such as this could expose pertinent issues and could at the same time create awareness among mathematics teachers.

1.2 The Namibian policy context

1.2.1 General background

Namibia is located on the south-west coast of Africa, bordering Angola and Zambia to the north and north-east respectively and Botswana and South Africa to the east and south respectively. The country has a total population of 2.1 million which comprises different ethnic and language groups. English is the official language and the medium of instruction from grade 4 although only about 7% of the population speaks English as a home language (Miranda, Amadhila, Dengeinge, & Shikongo, 2011, p. 3).

Namibia obtained its national independence in 1990 after a long national liberation struggle. Before independence, the country was characterised by the effects of apartheid policies. The country shared a racial educational policy background with South Africa; both countries were under the Bantu Education system. The Bantu Education is a South African segregation law which legalised several aspects of the apartheid system in the two countries; its major provision was to enforce racially separated educational facilities. Under the leadership of Dr van Zyl, the Bantu Education system was extended to Namibia via the 1962 Odendaal Commission of Inquiry. This Commission was established by the South African government to recommend a plan for the development of Namibia, more especially its non-white inhabitants, 'within the context of what has already been planned and put in practice' (Katjavivi, 1988, p. 72).

Under the Bantu system, the unequal distribution of academic mathematics education has often been illustrated by a quote from an address given in 1954 by Dr Verwoerd, the then Minister of Native Affairs, to the senate in South Africa. One of the quotes that follow highlight the intention to exclude people based on racial classification, while the other shows the level of education intended for the natives. The nature of the education intended for 'natives' is unambiguously expressed in Dr Verwoerd's quotes:

> *When I have control of native education, I will reform it so that natives will be taught from childhood that equality with Europeans is not for them. There is no place for him (a black child) in European society above the level of certain forms of labour … What is the use of teaching a Bantu child mathematics when it cannot use it in practice? (Quoted from Sethole, 2005, p. 2)*

and

> *There is no place for ... [the African] in the European community above the level of certain forms of labour, ... Education [will be] in Sub-standards A and B, and probably and to standard II including reading, writing and arithmetic through mother-tongue instruction, as well as a knowledge of English and Afrikaans, and the cardinal principles of the Christian religion. (Quoted from Katjavivi, 1988, p. 28)*

As can be deduced from the above remarks, mathematics was not considered 'useful' for the type of labour that black children were to be educated for. It is only after independence that Namibian policy brought about the context in which various inequities of the past could be addressed. Major education reforms took place, and new education policies were developed. Under the new Namibian education system, development plans are shaped by the four major goals of access, equity, quality, and democracy (Ministry of Education and Culture, 1993, p. 2). It is against this background that the current policy is aiming hard at providing quality education in which the injustices of the past are addressed. Mathematics education is one of many areas that need attention.

1.2.2 Structure of the Namibian school education

Namibia has 13 years of schooling. This includes five years of lower primary education comprising one year of pre-primary education, three years of grade 1 to 3 in which learners are usually taught in their mother tongue, and one year of grade 4 in which English is used as the medium of instruction (English is the medium of instruction from grade 4 onwards). Then there are three years of Upper Primary education (grade 5-7); three years of Junior Secondary education (grade 8-10); and two years of senior secondary education (grade 11-12) (Miranda et al., 2011).

The formal school system is also categorised into phases. Some of these phases are combined. These include the Pre-Primary phase (reception years); Primary phase, which is a combination of Lower Primary (grade 1-4) and Upper Primary phase (grade 5-7); and Secondary phase, which is a combination of the Junior Secondary phase (grade 8-10) and the Senior Secondary phase (grade 11-12). Some schools are referred to as Combined Schools, depending on the grades offered within the school. Schools do not strictly follow this arrangement because some schools provide both Primary and Secondary phases (Miranda et al., 2011). Student age group per phase may vary from those indicated due to grade repetition or late school registration by some learners. The schooling system is summarised in Figure 1.

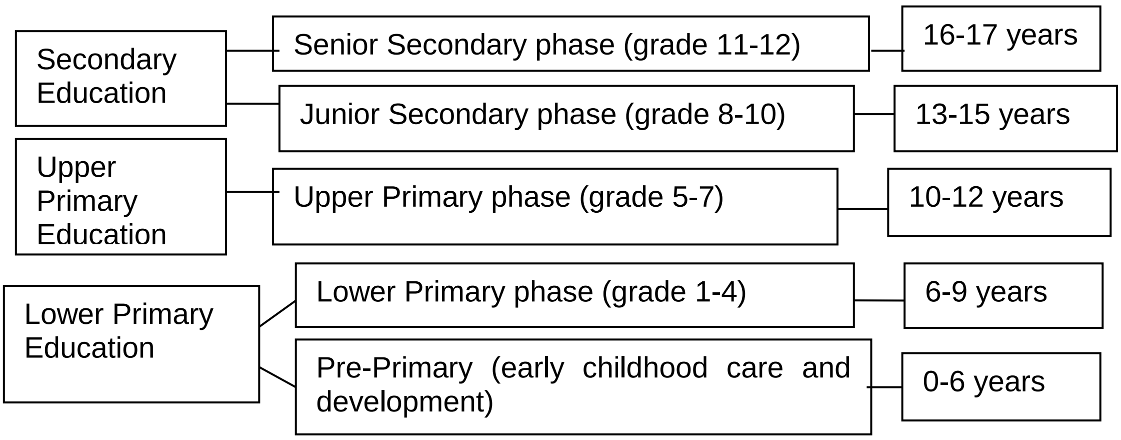


Figure 1: Structure of the school system in Namibia

1.2.3 The management structure of education

Namibia is divided into 14 Regional Directorates of Education, but there is a single Ministry of Education that administers basic and higher education as well as other training components. The Ministry is organised into four departments: Department of Schools/Formal Education; Department of Lifelong Learning; Department of Tertiary Education, Science and Technology; and the Department of Policy and Administration. The first three departments are directly responsible for education, with the third focusing on higher education. The fourth department is responsible for policy administration. The Department of Formal Education includes directorates such as the Directorate of Programme and Quality Assurance (PQA), the Directorate of National Examination and Assessment (DNEA), and the NIED.

NIED runs affairs of basic education, with the Ministry of Education overseeing all aspects. NIED commits itself to improving the quality and relevance of school curricula, teaching, and learning support material with a wide participation and involvement of stakeholders. NIED is organised into three divisions: Division of Curriculum and Development, Division of Professional and Resource Development, as well as General Services Section. The Division of Curriculum and Development houses six subdivisions, of which the subdivision of Mathematics, Natural Science, and Agriculture is one, and within which the Advisory Services for Mathematics is situated. This Department in liaison with the subject advisor at the Ministry’s Head Office coordinate advisory services with school mathematics teachers in the 14 Regional Directorates of Education. Mathematics is made compulsory for all grades (grade 1-12). However, after grade 10, there are three different streams students can opt for. From the lowest to the highest, these are examined by Core, Extended, and Higher Level Examination.

1.3 Promotion of academic-everyday relationships in the mathematics curriculum

This section is intended to serve as an introduction to Namibian policy documents on the idea of bridging school mathematics and the everyday in the classroom – the main subject that drove the inquiry in this study. This background information is essential for an understanding of what motivated this study and why a study of teacher practice by means of classroom observation is necessary. The National Curriculum for Basic Education (Ministry of Basic Education Sport and Culture, 2008) and the mathematics syllabi for Upper Primary and Junior Secondary education (Ministry of Education, 2010a, 2010b) indicate that in Namibia, the teaching and learning of mathematics is valued in its own right in order to promote access to advanced and specialised mathematics knowledge, which is an important goal of mathematics education. However, this is not the only goal of Namibia's compulsory mathematics education. In terms of teaching contents, these policy documents announce the need to cross borders, not only between different school subjects but also between academic mathematics and everyday knowledge.

1.3.1 The National Curriculum for Basic Education and the school mathematics syllabus

1.3.1.1 The National Curriculum for Basic Education

In justifying the need to summon the everyday to the mathematics classroom, the National Curriculum for Basic Education states, "we are situated in a natural and cultural context with which we interact, which affects us and which we draw upon to construct understanding" (Ministry of Basic Education Sport and Culture, 2008, p. 29). The document stresses that people learn through and by experiencing things, by reflecting on them, and that it is by reflecting on what has been experienced that the learner's understanding grows. Furthermore, this document declares that if learners are taught and learn by rote memorisation, they forget soon. However, if they are taught in a way which builds on what they already know and have experienced, and relate new knowledge to the reality around them, they tend to realise that learning in school can be meaningful (Ministry of Basic

Education Sport and Culture, 2008, pp. 29-30). The position of this policy document to discourage rote learning is a sign of moving away from what in the past has been called teaching that emphasises procedures.

Specifically, the national document further states that teaching and learning which does not build on that experience (learner experience and cultural context) will limit the learners' thinking, and that learners will not see the connection between the world outside school and what is being taught and learnt in school (Ministry of Basic Education Sport and Culture, 2008, pp. 29-30). The document further declares that teaching should always begin by helping learners realise what they already know and by relating to the environment within and around their schools. Emphasising that teaching needs to build on experience, the document further observes:

> *Learning in school must constantly relate to, involve, and extend the learners' prior knowledge and experience, and this must be complemented and challenged by the knowledge that school provides from beyond the immediate sphere of the learner. (Ministry of Basic Education, 2008, p. 30)*

The idea of relating what is being taught to learners' life worlds and experiences is also echoed in the subject curriculum and is elaborated next.

1.3.1.2 School mathematics syllabus

The primary focus of this study is on the Upper Primary and Junior Secondary levels. It does not include the Senior Secondary level. The Senior Secondary level is excluded because as the grades advance, the academic mathematics content also advances, which makes linking mathematics and the everyday less necessary or feasible. As a background for the study, it is necessary to present some key ideas of the two syllabi for Primary and Junior Secondary. Both syllabi acknowledge, "everybody uses mathematical practices in his or her daily life, and the style of thinking with which we recognise aspects as mathematical is part of our everyday functioning" (Ministry of Education, 2010a, p. 1, 2010b).

The syllabus further states that since all people make conjectures and test them using means such as classifying, enumerating, ordering and building them into generalisations, mathematics is therefore "a powerful language, which provides access to viewing the world" (Ministry of Education, 2010a, p. 1). This statement appears to hail not only the utilitarian aspect of mathematics but also promotes mathematics as an indispensable tool in understanding the world around people. Furthermore, the syllabus outlines general aims of teaching school mathematics in Namibia. It explicitly reveals that the aim of mathematics teaching in Namibian schools is to develop the students' competency in applying mathematics in the contexts of everyday situations and of other school subjects. This aspiration is expressed as follows:

> *The aims are to enable students to develop their ability to apply mathematics in the contexts of everyday situations and of other subjects that they may be studying. (Ministry of Education, 2010b, pp. 1-2)*

In addition to the aim of developing meaning and appreciation of mathematics, this statement appears to introduce another aim – that of developing a set of skills of applying mathematics in other contexts. What this quote or any other statement elsewhere in the curriculum documents do not seem to specify is how the idea of applying mathematics should be enacted in the classroom.

There is, however, one statement to be found in the mathematics syllabus which expands on the meaning of relationships between mathematics and other practices or experiences. The statement reads,

> *Mathematics is a universal language, it is only by local contextualization and application that younger learners will understand and appreciate the uses of mathematics. Where textbooks can only give general examples, it is up to the teacher to use and include local examples by developing appropriate worksheets and exercises. (Ministry of Education, 2010b, p. 3)*

Authors of the above statement appear to assume that relating school mathematics to students' everyday out-of-school practices and other related experiences is beneficial to student learning and appreciation of the usefulness of mathematics. As a way of realising a school mathematics curriculum that makes mathematics meaningful for learners, this mathematics document suggests that by application and local contextualisation, this goal can be achieved.

The declaration of the general aims of teaching mathematics in Namibian schools and the pronouncement in the statement cited above suggest a teaching approach which makes mathematics-everyday relationships in the classroom an important aspect to reflect on. This statement, in particular, suggests two central aspects in the teaching and learning of mathematics. One is an epistemological aspect, and the second is a pedagogical aspect. Since it appears to declare what mathematics is and how it should be taught/learnt, it is referred to in this study as a *central curriculum declamatory statement*. It not only shows what mathematics is conceived to be and how individuals come to know it but also declares how mathematics is to be taught and learnt in schools, or the classroom in particular.

While policy documents might contain many statements such as the foregoing, as this study later suggests, mathematics teachers often take little or no time to reflect on them. Educators usually take little or no time to determine ways in which school mathematics teachers make sense of them. Based on the centrality of the declamatory statement in terms of scope and vagueness in its expression, this study includes the question as to how it might be interpreted by subject advisors and teachers.

1.3.1.3 Possible interpretations of the curriculum declamatory statement

This section presents some analysis of the curriculum declamatory statement (Ministry of Education, 2010b, p. 3) in order to highlight the possible range of interpretations. As already indicated, the short statement indicates an epistemological aspect and points to a pedagogic aspect. This supposition is based on several grounds. *First*, the statement appears to have defined what mathematics is (‘a universal language’). *Secondly*, its authors propose how learners can ‘understand and appreciate the uses of mathematics’. *Thirdly*, the statement appears to highlight one of the bases for teaching mathematics (‘local contextualisation and application’). *Fourthly*, the statement urges that where textbooks can only give ‘general examples’, it is up to the teacher to ‘use and include local examples by developing appropriate worksheets and exercises’.

Mathematics, being a ‘universal language’, is open to several interpretations. It could, for example, imply that mathematics is a language that is spoken/written worldwide and hence can be used as a lingua franca. Alternatively, it could mean that mathematics is a scientific language which is adaptable to various purposes and activities. It could also suggest that mathematics is a common aspect of other activities or practices. In the statement, ‘universal’ is contrasted to ‘local’: “Mathematics is a universal language, it is only by local contextualisation and application that younger learners will understand and appreciate mathematics”. It is not entirely clear what is meant by the term ‘younger’, which might include the ages of learners in Lower Primary, Upper Primary and Junior Secondary. Furthermore, the logic that connects the first and the second clause needs unpacking. First, the use of the word *‘only’* in the second sentence appears to suggest that the two approaches (local contextualisation and application) are the exclusive methods, both of which are in contrast to the universality of mathematics, which does not offer any pedagogic approach. The word *‘only’* suggests that there is no other means, but by ‘local contextualisation and application’, a teacher could facilitate learners’ understanding of mathematics, the appreciation the subject, and its uses.

Likewise, the phrase 'local contextualisation' could mean different things in different contexts. This is because language interpretation relies on a context of language use. 'Local contextualisation' appears to invite the recruitment of diverse instructional strategies designed to bridge academic mathematics and student experiential realities. The syllabus echoes this proposal elsewhere in the document when it states that mathematical problems should always be exemplified in a context that is meaningful to the learners. This statement indeed calls for teaching to draw on students' cultures, familiar contexts and environments. The term 'local' could refer to something not broad, general or widespread. It could refer to something that relates to, is applicable to, or concerned with the cultures of a specific group of people, city, town or district but not to that of a larger area and hence be interpreted in terms of geographical or administrative location. It could be taken to only refer to the Namibian context. In other words, the term local could refer to something that is concerned with, applicable to, or belonging to the country specifically. If it is judged in terms of how students identify with their experiences, local could be interpreted to mean authentic and not inauthentic. It could also be something which relates to or characterises a particular locality or place in terms of culture or in terms of the community spaces in which students participate.

As these different interpretations entail different views about mathematics, it is important to empirically investigate how personnel with curricular responsibility acknowledge and react to the central statements in curriculum documents.

1.4 The importance of studying teachers' practice

First of all, in recognising that mathematics teachers have a major influence on the process of learning, mathematics teaching practice is an obvious target for research. Secondly, the above-mentioned curriculum documents have not only shown that the idea of bridging the academic and the everyday is a desirable aspect of school mathematics in Namibia but have also shown that this idea is an inevitable part of school mathematics pedagogy. These curriculum documents call for mathematics to be taught in ways that relate to a range of not specifically defined everyday experiences of the learners. To recruit the everyday, teachers have to bring in aspects of everyday out-of-school activities and practices and use them as resources for mathematical teaching. To establish meaning-making in the mathematics classroom might require the use of metaphors, analogies or stories. Nonetheless, the teaching of mathematics does not necessarily require teachers to make reference to everyday life and experiences. As a domain of practice, mathematics is about itself. This means that the mathematics activity has to refer to its own domain while it simultaneously tries to find ways of making its own domain more accessible to students, in particular, to those who are thought of as not pursuing mathematics as an academic career. Studies that look into classrooms are not only necessary for exploring how the curriculum is ‘enacted’ but also to determine how teachers negotiate different goals. Approaches to putting curriculum aspirations such as this into practice are not always obvious. Curriculum guidelines can never prescribe teaching; there is always room for interpretation, and hence teachers’ practices are not uniform.

Thirdly, curriculum documents’ statements of intent often mention desirable values, but the curriculum prescriptions which follow usually have little or nothing to say about their development and enactment. Curriculum aspirations might not have concrete guidelines to direct teachers on how to implement them. This is another reason why the study of teachers’ practice is essential. More studies are needed not only to determine how teachers deal with the mathematics-everyday relationship in their classrooms but also to ascertain the sense teachers make of these curriculum statements of intent. While the bridging of the academic and the everyday in school mathematics seems indispensable, there appears to be no consensus on how teachers should go about doing so. Sawyer (2008, p. 429) suggested, “the consensus that students should learn how to make mathematical connections does not extend to agreement about the ways in which students should be supported to do this”. As in the declamatory statement, it is often left to teachers to figure out for themselves what these curriculum aspirations mean and should entail in a particular classroom with a particular group of students. This poses a challenge for teachers in lesson planning and enactment, as shown by Sethole (2005b) and Jablonka (2008).

Finally, although the idea of bridging academic mathematics and the everyday is promoted in Namibian curriculum documents, findings from other empirical and theoretical studies do not only reveal pedagogic benefits in recruiting the everyday but also reveal how learning might be constrained by recruiting the everyday. There are tensions and pitfalls in the idea of incorporating the everyday in the mathematics classroom. These will be discussed in Chapter 2. The Namibian context is no exception. Hence, studying classrooms in this context could reveal further insights of general value for mathematics education.

1.5 Problem statement and rationale for the study

As has been outlined already, the Namibian curriculum generally demands that the learners' prior knowledge and experience should be 'involved', but this knowledge must be 'complemented and challenged' by the academic knowledge school provides. As to the teaching of mathematics, there is no clear advice, but only a general statement about the universality of mathematics, its applicability in everyday life, and the promotion of a teaching strategy by means of 'local contextualisation'.

Although this is a desirable pedagogy in mathematics classrooms, given the Namibian context, it appears as if there are no studies of classroom interaction at the micro level which specifically explored what mathematics teachers do in their classrooms to establish relationships between academic mathematics and the everyday. There might be a variety of strategies. Hence, this study aims to add to the understanding of teachers' classroom practice. As the practices of teachers vary, it is also important to investigate the reasons for their strategies of establishing relationships between the everyday and the academic in school mathematics. To explore this, the study will not only observe but also interview teachers. As not all teachers may read the official curriculum documents, it is also important to explore subject advisors' interpretations because they are the ones who provide professional development for teachers, and this also informs teachers' practice.

Although much appears to have been published in the field of mathematics education in terms of how relating academic mathematics content to the everyday might be enabled or constrained in practice, in Namibia the incorporation of such relationships into classroom practice is a relatively new idea. With the Namibian socio-cultural and economic context in mind, it seems particularly worthwhile to look at a sociologically informed framework. Therefore, the study could also contribute theoretical insights to mathematics education.

1.6 Organisation of the thesis

This thesis is divided into five main sections, which are as follows:

- The introductory section (Chapter 1) discussed the Namibian policy context and curriculum aims for connecting school mathematics and everyday in the classroom.

- The second section (Chapter 2) provides an account of the work which precedes this study. As academic-everyday relationship in mathematics is a very broad topic, the review of the literature will also need to be wide in scope.

- The third section (Chapters 3 and 4) is an orientation to the theoretical and methodological aspects of the study respectively. The overall research aim will be recapped in these sections.

- The fourth section consists of Chapters 5, 6 and 7. Chapter 5 gives an account of how mathematics teachers and their subject advisors interpret academic mathematics-everyday relationships. Chapter 6 gives an account of the analysis of mathematics lessons. Chapter 7 highlights one aspect of the analysis which focuses on non-mathematical contexts used by teachers.

- The last section is made up of Chapter 8, which is a concluding chapter in which the findings of the study are discussed.

PART II

2 Literature review

2.1 Introduction

The previous chapter provided an introduction and background to the study. This chapter presents prior research which touches on the relationship between 'pure' academic (school) mathematics and extra-mathematical structure that has a point of origin outside of the domain of mathematics. The intention is to illustrate different perspectives from which this relationship is approached. The chapter begins by considering terminologies used in the studies of academic and everyday (Section 2.2). In Section 2.3, the review outlines some studies of the everyday mathematics, critical mathematics education perspectives, ethnomathematics, contributions from recontextualisation studies, as well as studies of application and modelling of school mathematics. The focus is made on potentials, limitations, and tensions associated with the incorporation of the everyday into the mathematics classroom (Section 2.4). This chapter also points to a range of ideas used in mathematics education research as far as bridging mathematics and the everyday is concerned. The examples presented next highlight diversity within which the relationship between mathematics and the everyday is discussed.

2.2 Terminological considerations

2.2.1 Connecting the academic and the everyday

The phrase 'connecting school mathematics and students' everyday experiences' is used in the title of this thesis for lack of a better generic term that subsumes a range of ideas in mathematics education expressed from different theoretical perspectives. It has not been easy to pin down these ideas in a single and comprehensive sentence. 'Connecting' suggests the metaphor of 'bridging', a term used by Evans (1999) while reflecting on the problem of transfer of learning in mathematics and while looking at how mathematics could refer to students' everyday life and to other non-mathematical practices. Evans (1999, p. 28) suggested that to build bridges between practices, for example, one must try to identify areas where out-of-school practices might usefully 'interrelate' with mathematics. When Linchevski and Williams (1999, p. 132) investigated the idea of using intuition from everyday life to fill the gap in children's extension of number concepts, they refer to the same relationship as ‘making links’. The school mathematics-everyday relationship is also discussed in terms of ‘simulation’ of real-life situations through mathematics word problems (Palm, 2006).

Amongst others, the contrast between academic and everyday (mathematics) has been used in the title of a special issue of one publication by Arcavi (2002). Moschkovich (2002a) and Arcavi (2002) maintained that the term ‘everydayness’ or its use is contextual, especially when the question ‘Everyday for whom?’ is asked (Arcavi, 2002). For instance, Moschkovich (2002a, p. 1) explained that exploring the nature of mathematical patterns is considered an everyday activity for mathematicians. Referring to the same idea of the mathematics-everyday relationship, Moschkovich (2002b) used words such as ‘bringing everyday mathematics into the classroom’ (p. 1) and ‘including’ everyday or academic practices in classroom activities (p. 3). Similarly, while drawing on episodes from classroom discourse, which document interactions between teachers and students engaged in solving tasks that relate school mathematics to everyday practices, Jablonka (2008, p. 7) referred to the relationship between the two domains of practice and used the phrase ‘including particular aspects of everyday out-of-school practices as resources for mathematical activities’. On the other hand, Arcavi (2002, p. 12) wrote about ‘creating a bridge between everyday mathematical practices and mathematics in school’, and ‘harnessing or integrating aspects of out-of-school mathematical practices’ (p. 12).

The mathematics-everyday relationship is also discussed in terms of recruitment of authentic/inauthentic and far/near contexts (Sethole, 2004, 2005). In his discussion, Sethole (2004, p. 18) used words such as ‘incorporating the everyday in the mathematics’. Furthermore, in his study of learners’ perspectives, Sethole (2005) discussed summoning the everyday into the mathematics classroom and shifting mathematics-everyday boundaries or blurring boundaries between mathematics and the everyday. The mathematics-everyday relationship is also discussed in terms of horizontal and vertical mathematisation, and their functions (Jablonka, 2008; Treffers, 1987). All these terminologies imply the summoning of the everyday into the mathematics classroom. In pointing to the asymmetry, in his discussion of the mathematics-everyday relationship, Dowling (1998, 2007) used terminologies such as casting a gaze, pushing, and fetching other practices (see Chapter 3). Similarly, the researcher perceives academic school mathematics and everyday practices as distinct domains of activities.

The term ‘connecting’ in the title of the thesis refers to a process where a teacher is recruiting non-mathematical objects or language to establish links between school mathematics and assumed learners' everyday life experiences or knowledge. In this thesis, the term 'everyday' refers to out-of-school non-professional practices, but not to specialised occupations.

2.2.2 The notions of 'real context' and 'real world'

A number of studies that investigated the relationship between the academic and the everyday – whether inside or outside the mathematics classroom – made use of the term 'context'. Because of this, "there is a plethora of meanings that the word context conveys in mathematics education" (Stillman, 2012, p. abcde+3). Some authors such as Carraher and Schliemann (2002, p. 138) even cautioned that the casualness with which one employs the term 'context' can also be deceptive. For this reason, the term needs unpacking. Generally, non-mathematical situations or elements of out-of-school practices are referred to as 'context'. For example, Borasi (1986, p. 129) defined a context as "a situation in which a problem is embedded", and its role is to "provide a problem solver with the information that may enable the solution of the problem".

Wedege (1999) contended that to know and not to know something is a question of context, and therefore, the meaning of any term depends on the individual, the situation and the context (p. 205). Wedege clarified that whenever this term is used, the context may suggest a situation context, or it might refer to a task context. The 'situation context' refers to the 'context for learning, using and knowing mathematics' (Wedege, 1999, p. 207). For example, in speaking, an individual might refer to the historical context of mathematics. The task context has to do with 'representing reality in tasks, word problems, examples, textbooks, teaching materials' (p. 206).

In their study, Sullivan and Zevenberger (2003) also used the term 'context' in two ways. They talked about contexts of tasks (p. 109) and contexts of learning environment (e.g. classroom context) (p. 111). In the first instance, the context refers to 'the choice of the situation in which the mathematics is embedded. In the second instance, the term 'context' is used to mean 'the learning environment in which the task is used' (Sullivan et al., 2003, p. 118). Sullivan and Zevenberger's definition of contexts of tasks does not seem different from Wedege's task context. However, Wedege's definition (historical context of mathematics) appears to be more general and broader than Sullivan and Zevenberger's (contexts of learning environment, e.g. classroom). This is because Wedege not only referred to the context of learning but also to the context of using and knowing mathematics. From Wedege's paper, it is not that clear what the context of using and the context of knowing mathematics entailed. In this study, whenever the term is used, it is referring to Wedege's latter definition. Where the term is used to refer to a situation context, it is specified, such as 'school mathematics context'.

In explaining what a context is, other researchers maintained that context is not reducible to the physical settings or social structures in which the student is passively situated. In particular, Carraher and Schliemann (2002, p. 146) suggested that contexts can be imagined, alluded to, insinuated, explicitly created on the fly, or carefully constructed over long periods of time by both teachers and students. They also suggested that even the apparent context-free activities of applying syntax transformation rules to algebraic expressions can be considered as meaningful contexts (p. 146). Hence, according to Carraher and Schliemann, a 'context-free' activity such as $3x + 4 = 7$ could also be considered as a context in mathematics.

So far, these explications provide three angles from which this term may be viewed: context as a socio-historical context of an activity, context as the learning environment (classroom), and context as in a mathematical task in which the everyday is embedded. These distinctions in the definition are crucial, as they suggest different theoretical perspectives.

Another term that is mostly utilised together with the term 'context' is the term 'real' and derivations, as in realistic contexts, real-life situation, or real world. The term realistic or the notion of realness is often misunderstood. The term realistic can be interpreted as meaning 'to imagine' (Heuvel-Panhuizen, 2003, pp. 9-10). Thus when the term 'realistic' is employed (such as in Realistic Mathematics Education), this should be seen as referring more to the intention that students are offered problem situations which they can imagine rather than to the 'realness' or authenticity of those problems (Palm, 2006).

Heuvel-Panhuizen (2003) stressed that even when students are given a context that they can imagine, this does not mean that authentic contexts are not important. From this point of view, contexts recruited in the mathematics classroom can be both authentic or inauthentic (Sethole, 2004, 2005a). In line with Heuvel-Panhuizen (2003), Carraher and Schliemann (2002, p. 151) stated that the virtue of out-of-school situations employed as contexts 'lies not in their realism but rather in their meaningfulness'. School mathematics should therefore be seen as engaging students in situations that are either realistic or look real to students.

With regard to the notion of real, the term is also used in phrases such as 'real world' or 'real-life situation'. Moschkovich (2002a, p. 93) asserted that when the phrase is used to describe curriculum, assessments, or mathematical activity, it could mean 'activities in which students might engage during the course of their present daily lives', or it could refer to 'future activities in which students might engage as adults at work'. In this study, if the notion of 'real' is used, it encompasses the recruitment of both authentic and imagined contexts, including fantasy settings, as these are as 'real' as any other imagined contexts when used to communicate mathematics ideas and their meanings.

2.2.3 Classifications of 'real(istic) contexts'

Since mathematics teachers and designers of curricular materials are often expected to incorporate realistic or real contexts, researchers have used classifications of contexts in terms of their 'realness'. For example, Palm (2006) described features of school mathematics tasks which make them more or less authentic simulations of the corresponding 'real' activities. In clarifying what makes a realistic context useful for mathematics teaching, Wiliam (1997, p. 8) posited, "a realistic context is characterised by the extent to which it is shared by students, and its fit with the mathematical structures being taught". Wiliam went on to categorise contexts that are used in mathematics teaching in three different ways. First, Wiliam submitted that there are contexts which bear little or no relation to the mathematics being taught and which serve primarily to legitimise the subject matter ('maths looking for somewhere to happen'). Second, there are contexts that have an inherent structure with elements that can be mapped onto the mathematical structures being taught ('realistic mathematics'). Third, there are contexts in which the primary aim is the resolution of a problem in which no particular (or even any) mathematics need necessarily be used ('real problems') (Wiliam, 1997, p. 8). These categorisations are also crucial for evaluating the type of contexts teachers might use in their lessons.

Similarly, Meyer, Dekker, and Querelle (2001) named and discussed characteristics of high-quality 'contexts'. They suggested that a context should (1) support the mathematics, not overwhelm it; (2) be real, or at least, imaginable, to the student; (3) be varied, not repeated over and over; (4) result in real problems to solve; (5) be sensitive to cultural, gender, and racial norms, and not exclude some students; and (6) should allow the student to make a mathematical model.

If viewed from the perspective of usefulness in deriving a particular mathematical structure or process, several 'realistic contexts' could be used to teach the same mathematical idea. This can be illustrated by the teaching of 'directed numbers' as an example. Contexts here range from those that use counters of different colours in which one colour annihilates another to those that include examples such as rising and falling of sea levels or temperature on thermometers. Wiliam (1997, p. 15) suggested that when one compares these approaches, three aspects of the context or model appear to be particularly important. These components are *commonality*, *match*, and the *range* of the context. *Commonality* of context has to do with whether the context is more or less accessible, or familiar to students. Wiliam postulated that a task metaphor itself can also be classified as either universally shared, commonly shared, or not commonly shared (p. 15) and added that a mathematical problem can be rephrased and presented in different metaphorical forms, as long as its meaning can remain the same. *Match*, according to Wiliam (1997, pp. 15-16), entails the "fit between the core mathematical activity intended and the possible interpretations of, or within the task". Since when the task is set, there may be features in the task description which students are expected to suppress, he suggested that certain attributes of the task metaphor might map onto corresponding attributes within the target activity, while others may not. Equally, in a task, there can be 'unwanted attributes', and these 'undesired features can contribute crucially to the difficulty' of the task (Wiliam, 1997, p. 16). Wiliam further explained that this can be the case because many students will be misled into tackling different kinds of activities. This highlights the important point of 'misreading' a task.

The *range* has to do with how far answering the question in a particular context takes the teacher and his or her learners in terms of mathematics (Wiliam, 1997, p. 16). Using the example of teaching directed numbers, Wiliam cautions that 'envisaging negative numbers as temperatures above or below zero may be very useful for understanding ordering of integers, and may even provide good pictures for adding directed number'. However, scenarios where temperatures below zero are subtracted from each other, or are multiplied, is rather more difficult (p. 16). This context may not take students far in terms of facilitating their mathematical understanding of multiplication of integers.

2.3 Conceptions of connecting the academic and the everyday

Critical mathematics education, ethnomathematics, and studies on everyday mathematics, Realistic Mathematics Education, mathematical modelling and applications are some of the most notable perspectives and studies which offer inspiration and a theoretical base for thinking about the everyday and mathematics relationship in the classroom. Though differently motivated, these perspectives and curriculum notions engage with the epistemological nature of mathematics and the pedagogic value of recruiting the everyday for teaching and learning purposes. Overall, these are linked to the goal of making mathematics concepts, structures and operations more meaningful and accessible, and “to show the usefulness of specific ideas and skills being studied” (Sullivan et al., 2003, p. 107). While a comprehensive review would be far beyond the scope and purpose of this thesis, it is necessary to review some of the curriculum conceptions and related studies, as empirical analysis might reveal traces of these. The presentation of the conceptions and of some examples, however, will inevitably simplify the evolution of these rather complex theories and curriculum approaches. If these are presented under one name, this is not to suggest that there are coherent views.

Critical mathematics education: Critical mathematics education together with ethnomathematics (discussed next) are two positions that have not only elaborated the cultural, social and political dimension of mathematics but also of mathematics education (Vithal & Skovsmose, 1997). Vithal and Skovsmose maintained that these two conceptions attempt to develop an ‘alternative’ mathematics education which expresses not only social awareness but also political responsibility. Social awareness and political responsibility are some of the important aspects of everyday life which school mathematics needs to promote. Critical mathematics education argues for embedding mathematics within a socio-political context and emphasises the idea that mathematics education should engage students and educate them to become critical thinkers. This perspective raises issues of ethics and moral values, and questions the role of mathematics education in exposing values, as well as mathematics teachers’ commitment to children and mankind (D’Ambrosio, 1999, p. 131).

For example, Sánchez and Blomhøj (2010) observed that although the official justification for teaching mathematics is to provide students with mathematical understanding, often it is not discussed how students’ understanding of mathematics is relevant to them. Sánchez and Blomhøj asserted that recruiting the everyday in mathematics is crucial in assisting both teachers and students to understand the significance of what they are learning. In particular, they proposed that often mathematics is not presented to the students as a tool to help them understand political and economic realities. The issue of discussing values in mathematics education is central, not only to scientific and technological development but also because scientific and technological development can be both beneficial and destructive to humanity. Hence, it is crucial that students be given opportunities to discuss those issues.

Other critical mathematics teachers, such as Skovsmose and Valero (2001), discouraged any view that portrays mathematics as being an impartial, neutral and non-aligned subject. They stressed this point as follows:

> *Mathematics cannot be assumed any more to be the 'queen of sciences', sleeping in the limbo of neutrality, a-sociality, a-morality, and a-politicy. (Skovsmose & Valero, 2001, p. 52)*

The foregoing suggests that mathematics teachers should not perceive school mathematics as a subject immune to political and social issues that students encounter in their daily lives and which affect them.

One could ask how the idea of turning students into critical thinkers might be realised. D'Ambrosio (1999, p. 131) suggested a curriculum conception that is organised around three strands: literacy, matheracy, and technoracy. Of special interest among these strands is the idea of matheracy, which as both Skovsmose and AlrØ (2002) and D'Ambrosio (1999) propose needs to characterise a wider role of school mathematics. The term matheracy denotes the idea of developing students' capability to 'draw conclusions from data, make inferences, propose hypotheses, and draw conclusions from the results of calculations' (D'Ambrosio, 1999, pp. 133-134). For D'Ambrosio, this set of capabilities is the first step towards an intellectual and critical stance which is lacking in school education.

Skovsmose (1985) also made specific suggestions for the mathematics curriculum and pedagogy. Skovsmose stressed that problems taught should relate to fundamental social situations and conflicts, and that education should enable students to realise these problems as something that affects them either socially or personally. While Skovsmose argued for the inclusion of problems relating to social issues, he is not in favour of problems that belong to what he termed 'play-realities'. Play-realities are those problem situations that have no significant purpose 'except as an illustration of mathematics as a science of hypothetical situations' (Skovsmose, 1985, p. 338).

A number of studies present investigative tasks that reflect a critical mathematics perspective. For example, the classroom modelling experience presented by Barbosa (2006, p. 294) is an investigative task exemplary of an activity promoted by the critical mathematics education perspective, whose context had strong social implications. The activity occurred in a 7th-grade class in a rural public school in Brazil. The task was an advertisement from a local newspaper about the local government's programme to distribute bean and corn seeds to farmers. Many of the students in the 7th-grade class were benefiting from the programme, and therefore, the context or problem situation would be interesting to them, and students were invited to discuss it in class. The task referred to the students' everyday lives outside of school, and it directly involved their families. In this sense, the situation was authentic.

Another example is the investigative task of Gutstein and Peterson (2005) on the frequency of police stops in relation to the race of the driver.

Ethnomathematics: Ethnomathematics is another perspective and line of research in mathematics education which supports the idea of summoning the everyday onto school mathematics. To describe ethnomathematics is not an easy endeavour because "historically the term ethnomathematics has been defined at different levels" (Gerdes, 1994, p. 19). The term is defined in terms of the cultural anthropology of mathematics and mathematical education. However, Gerdes maintained that the term 'ethnomathematics' can be conceptualised in two ways: as 'the mathematics practised among identifiable cultural groups' or as a "field of research that tries to study mathematics (or mathematical ideas) in its (their) relationship to the whole of cultural and social life" (Gerdes, 1994, pp. 19-20).

D'Ambrosio (1985) proposed another way in which the term ethnomathematics could be conceptualised. He contended that the term suggests a much broader interpretation that combines two words: mathematics and ethno. The term ethno refers to 'identifiable cultural groups, and these are the national tribal societies, labour groups, children of certain age brackets, professional classes and so on' (p. 45). When D'Ambrosio contrasted ethnomathematics with academic mathematics (i.e. the mathematics which is taught and learnt in the schools), D'Ambrosio referred to ethnomathematics as the mathematics which is practised by an identifiable cultural group, and these groups may be labour groups, children of a certain age bracket, or professional classes.

In mathematics education research, ethnomathematics is described as a branch that emerged in opposition to mainstream discourse in mathematics education (Jablonka & Gellert, 2012). As a way of thinking, it challenges, disapproves and disagrees with the Eurocentric bias of mathematics education in most curricula and textbooks developed in industrialised countries and imported into former colonies (D'Ambrosio, 1997). Highlighting that historical era, Gerdes (1994, p. 19) noted that during the period of 1970 to the 1980s, there was a 'growing awareness and resistance among teachers and didacticians of mathematics (in developing countries, and later also in other countries) against the racist and (neo)colonial prejudices related to mathematics, against the Eurocentrism in mathematics and its history'.

The idea that ethnomathematics emerged as an opposition to mainstream discourse is also highlighted by critical mathematics education researchers. Vithal and Skovsmose (1997, p. 134) confirmed that ethnomathematics arose to challenge the traditional history of mathematics, in which mathematics historians are criticised for ignoring, devaluing, distorting or marginalising the contributions of cultures outside Europe to the body of knowledge that came to be entirely referred to as 'Western' mathematics. They suggest that ethnomathematics can also be understood as a reaction to the cultural imperialism which was embedded in modernisation theory. Illustrating this idea further, Vithal and Skovsmose explained how modernisation theory was used by some industrialised nations as a necessary liberalising force and as a progressive way to bring about development in 'underdeveloped' countries, and this resulted in an influx of foreign textbooks in these Third World countries (p. 132). Namibia is one of these developing countries that have been swarmed by foreign textbooks.

As a reaction against Eurocentric ideas, ethnomathematicians foresaw an urgent need for both industrialised and Third World countries to multi-culturalise their mathematics curricula (Gerdes, 1988b, p. 3). Specifically, ethnomathematics promoted the idea of the necessity to re-evaluate total school experience in view of the educational failure of many children from ethnic minority communities. Signposting the new desired form of pedagogy, proponents promoted the idea of defreezing mathematical thinking in cultural practices. For example, Gerdes believed that by defrosting mathematical thinking frozen in cultural practices and activities, one stimulates reflection on the impact of colonialism, historical, political and cultural dimension of mathematics (Gerdes, 1985, 1986, 1988a, 1988b).

Against this background, suggestions were made that the content of mathematics education needed to be rooted in the mathematics implicit in the culture with which the children are familiar (Vithal & Skovsmose, 1997, p. 133). The idea of rooting the content of mathematics education in the culture clearly suggests that this perspective supports the connecting of academic mathematics and the everyday. Mathematics then is understood as a cultural product (Gerdes, 1994). It is a cultural product, in that ethnomathematicians believe that 'every people, every culture and every subculture develops its own particular mathematics' (Gerdes, 1994, p. 20).

Mathematics is also perceived as a culturally homogeneous enterprise because 'it draws on traditions, symbol systems, ideas, and techniques which have evolved over the course of centuries' (Carraher & Schliemann, 2002). In line with this view, Carraher and Schliemann maintained that mathematics originated in human activities such as surveying, astronomy, building, commerce, and navigation but eventually became a nearly autonomous field of endeavour with its own subject matter, purposes, tools, and concerns (p. 133). Apart from being a general cultural product shared by different cultures, mathematics is also perceived as a ‘value-laden’ knowledge (Bishop, 1994, p. 15).

Some ethnomathematicians became convinced that investigating indigenous mathematics is a necessary way of building effective bridges between indigenous mathematics and the mathematics taught in schools. In particular, Gay and Cole (1967, p. 94) proposed that ‘teachers should begin with the materials of the indigenous culture and should lead the children to use such materials in a creative way’. Concurring with the proposal of Gay and Cole, Gerdes (1988b, pp. 18-19) also suggested possible ways of using traditional Angolan sand drawing in the mathematics classroom. Furthermore, Gerdes construed the idea of introducing these into the mathematics curriculum as a contribution to the revival, reinforcement and valuing of such a practice.

In summary, ethnomathematics promotes the idea that mathematics is practised among different cultural groups. Its “identity depends largely on the focus of interest, on motivation” (D’Ambrosio, 1991, p. 22). Further, it promotes the realisation that mathematics manifests differently in different cultures, often in ways that do not belong to the realm of academic mathematics. This literature revealed that ethnomathematics is a broad term, and that researchers in this field are motivated by different interests (D’Ambrosio, 1985, p. 45). Because of a number of different strands of research conducted in the field, a range of concepts have emerged, and this has also contributed to difficulties in defining the term. Some concepts emerged which are used by ethnomathematicians to contrast with academic mathematics, that is, “the school mathematics of the transplanted and imported curriculum” (Gerdes, 1994, p. 19). These include indigenous mathematics, sociomathematics of Africa, informal mathematics, mathematics in the (African) socio-cultural environment, spontaneous mathematics, oral mathematics, oppressed mathematics, non-standard mathematics, hidden or frozen mathematics, and folk mathematics. Details on what these concepts entail are traceable (Gerdes, 1994, pp. 19-20). These concepts not only point to the broadness of the ethnomathematics perspective but also point to the diversity of research conducted in this field.

Research on everyday mathematics: Related to ethnomathematics are efforts to innovate mathematics classroom practice informed by findings from studies of everyday practices. In particular, Carraher and Schliemann (2002, p. 131) attested that research in ‘everyday mathematics has given support to diverse and often contradictory interpretations of the roles of schools in mathematics education’. These investigations become crucial to the idea of incorporating the everyday because of their contributions to the differences between learning and doing mathematics in out-of-school practices and learning in school. Studies of everyday practices not only contributed knowledge to how mathematics is carried out in various practices but also highlighted the importance and relevance of informal mathematics to mathematics education – which might be a confrontation of different forms.

It has been reported that as a reaction to recommendations made for classroom practice, a number of mathematics education researchers in this line of research (everyday mathematics) examined those recommendations and came up with discussions which inform thinking about the academic-everyday relationship in a mathematics classroom. Moschkovich (2002, p. 1) reported on recommendations made by the National Council of Teachers of Mathematics [NCTM] (1989, 2000), as well as the consequences which followed these. Moschkovich revealed that one of these recommendations was to close the gap between learning mathematics in and out of school, and this was to be done by engaging students in real-world mathematics rather than mathematics isolated from its applications. Specifically, Moschkovich mentioned that this recommendation was informed by research that uncovers mathematics practices in everyday activities. The second recommendation, however, was to make mathematics classrooms reflect the practices of mathematicians (Moschkovich, 2002, p. 1).

Moschkovich, 2002 believed that the two proposals had different implications for classroom practice that needed to be revealed. For instance, one recommendation was seen as inviting classroom activities to parallel everyday mathematics practices, and the other was seen as emphasising that classroom activities parallel activities of academic mathematical practices. Moschkovich foresaw possible tensions between them. This is why she proposed that 'one way to think about issues involved in bringing everyday mathematics into the classroom was to juxtapose everyday and academic mathematical practices as models for what happens in mathematics classrooms' (Moschkovich, 2002, p. 1). What exactly such a juxtaposition would entail remains unclear.

Arcavi (2002, p. 14) specifically noted that apart from studying mathematical practices of specific communities, other efforts were directed towards children's lives. Arcavi argued that the premise in support of bridging everyday and academic mathematical practices was to build on what students were familiar with. Arcavi noted how more studies were needed to uncover situations that may seem non-mathematical to the children but have the potential to serve as springboards to academic mathematics (p. 30). Since educators wanted curriculum and classroom practice 'to build on what students are familiar with, be it contextual content or informal and everyday reasoning skills', it was seen as best if research could focus on what people do in their everyday life (Arcavi, 2002, p. 25).

Consequently, debates among the mathematics education community about "the role of everyday mathematics in instruction, and about the relationship between everyday and academic mathematical practices" arose (Moschkovich & Brenner, 2002, p. v). Researchers in mathematics education began to see everyday and academic activities as complex and varied resources supporting students' mathematical thinking and learning (p. vi). Suggestions in terms of the school mathematics curriculum were made. As per the suggestions of Masingira (1993, pp. 5-13), curriculum was to include a wide variety of rich problems that (a) build upon the mathematical understanding students have from their everyday experiences, and (b) students were to be engaged in doing mathematics in ways that are similar to doing mathematics in out-of-school situations (Masingila, 1993, p. 5). School mathematics teaching was to build on students' out-of-school knowledge, teach students problem-solving, and use the apprenticeship models in the classroom (Masingila, 1993, pp. 5-13).

Motivated by the need to 'close the gap between students' use of mathematics in school and their use outside', Masingila (2002, p. 30) examined students' perceptions of their everyday mathematics practices. Masingila wanted to gain insight into how middle school students perceived the use of mathematics in out-of-school situations (Masingila, 2002, p. 37). The interviews revealed that the use of mathematics that students mentioned was in line with what Bishop (1988) identified earlier. Earlier, Bishop (1988, pp. 182-184) analysed educational situations involving cultural issues and identified six fundamental ideas that he perceived as universal among all cultural groups. These are ability to count, locate, measure, design, play, and explain. Masingila's study confirmed that indeed students make use of mathematics knowledge and ideas gained in school, although not always.

The list of these studies on the everyday-school mathematics relationship is vast. Further work done in this line of research that informed an understanding of the mathematics-everyday relationship in the classroom are studies by Civil (2002). Civil (2002) explored the tensions and compromises resulting from what seemed to be different conceptions of what mathematics is and what mathematics children should learn in school. After reflecting on the different beliefs, values, and practices in mathematics that inform actions in the classroom, Civil declared that she did not want students' everyday mathematics to serve simply as a source of motivation. Taking a different approach, Civil 'worked towards having children working on mathematics like mathematicians'. Civil engaged fifth graders to work on open-ended and investigative situations in which they shared ideas, strategies, and jointly negotiated meanings (Civil, 2002, p. 40). If classroom mathematics is to encourage students to work like mathematicians, then Civil's examples of engaging students are examples that could be emulated by other teachers.

Another related contribution brought forward is the categorisation of mathematics (Civil, 2002, pp. 41-45; Moschkovich, 2002a). In particular, Moschkovich (2002a) noted that there is *academic mathematics*, *school mathematics*, *everyday mathematics*, and *workplace mathematics*. Academic mathematics, which the researcher believes is the same as Civil's notion of a mathematician's mathematics, refers to the practices of academic mathematicians. School mathematics refers to the practices of students and teachers in school. Everyday mathematics refers to mathematical practices that adults or children engage in, other than school or academic mathematics (e.g. shopping and candy selling). Lastly, workplace mathematics, which is considered a subset of everyday practices, refers to the practices of adults or children in places other than schools or academic mathematics (Moschkovich, 2002, p. 2). Moschkovich acknowledged that these labels can be misleading – they are complex, contested, and the categories are not mutually exclusive.

Realistic Mathematics Education (RME): RME is an approach and philosophy about teaching that originated from a Dutch research institution (Freudenthal Institute, former Institute for the Development of Mathematics – IO&WO). As a curriculum framework developed for schools, RME came as a reaction to New Math (Fauzan, 2002, p. 33). It is described as a teaching approach in which mathematics education is conceived as a human activity (Freudenthal, 1973). In terms of mathematics teaching, Freudenthal proposed mathematics filled with relations. Freudenthal preferred *lived-through reality* rather than *dead mock reality* that might be invented with the only purpose of serving as an example of application (Freudenthal, 1973, p. 73). Further, Freudenthal emphasised that mathematics is not only something that is meant for future mathematicians.

In RME, learning mathematics means doing mathematics, and its teaching approach to mathematics prioritises solving realistic problems. Consisting of six principles, RME reflects a certain view of mathematics as a subject, on how children learn mathematics, and on how mathematics should be taught (Van den Heuvel-Panhuizen, 2000, p. 4). Van den Heuvel-Panhuizen (2005, p. 2) revealed that RME promoted the proposal of Freudenthal (1968) of teaching mathematics as useful, its aim being to enable students to apply mathematics. Freudenthal suggested, "if mathematics was to be of human value, it had to be connected to reality, stay close to children's experience and be relevant to society" (Van den Heuvel-

Panhuizen, 2000, p. 1). Instead of viewing mathematics as a subject to be transmitted in its pure form, it needs to be viewed as an activity in which humans engage (Van den Heuvel-Panhuizen, 2000, p. 1). This means that in a realistic approach, mathematics is seen as an activity – an activity in which everyday life problems are solved as a starting point (Gravemeijer, 1994). In the RME process, the context only needs to be realistic and not authentic. Contexts provide a starting point, but at some point, they are abandoned in favour of verbal mathematisation.

Furthermore, RME is developed alongside the idea of mathematisation. Highlighting the concept of mathematisation, Jablonka and Gellert (2007) defined it as a process in which something is rendered mathematical. They discuss vertical and horizontal mathematisation, a distinction made by Treffers (1987). These two modes refer to the processes of formulating mathematics classroom activities. Horizontal mathematisation refers to the process of formulating mathematics activities in which meanings are often developed from out-of-school experiences, whereas vertical mathematisation refers to the process of formalising activities within the domain of academic mathematics (Jablonka & Gellert, 2007). Gravemeijer (1997) termed these processes *mathematising,* which he regarded as a key in classroom mathematics. In the same manner, Arcavi (2002, p. 21) viewed the process of mathematisation as a powerful idea to bridge the gap between everyday mathematics and academic mathematics. This is because there is provision for students' idiosyncratic ideas that serve as springboards towards a more formal mathematics.

Mathematical modelling and application perspective: In an attempt to bring references together, some challenges were faced. In particular, it appeared difficult to separate the notion of mathematical modelling and applications from RME. For instance, when Jablonka and Gellert (2011) mapped equity concerns about mathematics modelling in primary and secondary mathematics classrooms, they described RME as a form of mathematical modelling that is subordinated to the evaluative principles of school mathematics, and hence maintained strong classification of curriculum content. Jablonka and Gellert drew on Bernstein's notion of classification and on Dowling's scheme of domains of activities (see Chapter 3).

Concerned with the effects of weakly framed criteria for school mathematics tasks, Jablonka and Gellert (2012) acknowledged that mathematics modelling is a rather vaguely defined term, especially for a curriculum conception that comprises many different classroom activities. They maintained that modelling conceptions can be distinguished by the strength of the internal and external classification of the respective knowledge domains in classroom modelling activities (p. 295). Further, they argued that there can be two modes of school mathematical modelling which differ in terms of the relationships between the knowledge domains involved (p. 297). Jablonka and Gellert (2012) asserted that different versions of mathematical modelling in the classroom imply variations of classification. For example, if the situation chosen for modelling is selected for mathematical reasons, then the external classification will be strong, whereas the internal classification becomes weaker because a mix of different mathematical topics and procedures are valid. If the situation for a modelling activity is selected because of the social importance of a problem, then both external and internal classification will be rather weak (Jablonka & Gellert, 2012, p. 297).

Basically, applications and modelling are ‘concerned with the relations between mathematics and the real world’ (Blum, 2002, p. 149). Focusing on the way mathematics applications and modelling are used at classroom level, Blum and Niss (1991, p. 37) posited that mathematics modelling refers to a process in which one can systematically apply mathematics to the real world. Different from the notion of real referred to in Section 2.2.2 where realness refers to something that a student can imagine, in this case, *real world* refers to the “rest of the world” outside mathematics (Blum & Niss, 1991). Blum and Niss noted that the world outside mathematics might include school or university subjects, or disciplines different from mathematics, or everyday life and the world around people. Although applications and modelling are mostly used as a combination to denote any relations between the real world and mathematics, Blum (2002, p. 153) differentiated them further and emphasised that the term ‘modelling’ focuses on the direction from reality to mathematics, while the term ‘application’ focuses on the opposite direction from mathematics to reality.

When it comes to classroom practice, the notion of mathematics application is not unproblematic. In particular, Sloyer (1976a, p. 19) indicated that the idea of mathematics application is usually misunderstood by mathematics teachers. Sloyer stated that usually there is confusion among teachers over teaching of mathematical structures and applications of mathematics. In particular, Sloyer (1976a, p. 19) contended that ‘there is ambiguity as to what actually constitutes an application of mathematics’. Highlighting this ambiguity, Sloyer used an example in which he stated that some teachers assume that recruiting some piece of real-world language in mathematics problems constitutes mathematical modelling. Disagreeing with this assumption, he argued that mathematics applications entail more than just a mere use of ‘real-world’ language. This view approaches the notion of applications as mathematising or modelling. It is not clear from the Namibian mathematics curriculum whether the term application is the same as mathematics modelling and which approach Namibian mathematics teachers are expected to adopt.

There are similar definitions for mathematical modelling such as those from Smith (1996, p. 15) and Van der Heuvel-Panhuizen (2003). Smith defined mathematical modelling as a 'cyclical process' that "begins with a problem that originates in the real world". On the other hand, Van der Heuvel-Panhuizen (2003) referred to modelling as a representation of problem situations which reflect essential aspects of mathematical concepts and structures relevant to the problem situation. The similarity between these definitions lies in the fact that problem situations originate in the real world, but the latter version is one that resembles strong knowledge classification in the curriculum (Jablonka & Gellert, 2012).

Other researchers have also tried to explain what modelling in a classroom is about. In describing modelling in a school, Julie (2002) used two metaphors and differentiated modelling as a content and as a vehicle. Explicating the two metaphors proposed earlier by Julie, Barbosa (2006, p. 293) postulated that 'the former emphasises the development of the competencies needed to model real situations, while the latter views modelling as a way to teach mathematical concepts'. These two distinctions again appear to suggest two different paths undertaken in school mathematics modelling.

In a similar way, modelling in mathematics instruction is seen as serving two purposes. The *first* is to provide students with knowledge and abilities concerning mathematics as a subject in itself, and the *second* is to provide students with knowledge and abilities to deal with other subjects that mathematics is supposed to support (Blum & Niss, 1991, p. 41). This second purpose concurs with what Zbiek and Conner see as the rationale for modelling in the mathematics classroom. Zbiek and Conner (2006, p. 89) understand the rationale for mathematical modelling in the mathematics classroom as 'to prepare students to work professionally with mathematical models, and to motivate them to study mathematics by showing them the real-world applicability of mathematical ideas, and to provide students with opportunities to integrate mathematics with other curriculum areas'. Zbiek and Conner's modelling conception of preparing students to work professionally with mathematical models appears to suggest an environment where students have to be taught advanced mathematics and its application to real life, rather than just being taught mathematics sugar-coated with real-life situations.

Other scholars differ in their conception of modelling with regard to the level of teaching students have to receive. For example, contrary to the conception of mathematical modelling of Zbiek and Conner (2006), some mathematics education researchers are of the opinion that the purpose of modelling at the classroom level is not necessarily to turn students into professional modellers. Jablonka and Gellert (2012, p. 295) noted that the primary goal of including mathematical modelling activities in students' mathematics experiences within schools is to provide an alternative and supposedly *engaging* setting in which students learn mathematics without the primary goal of becoming proficient modellers.

With all these definitions of modelling at hand, one might ask which ones are considered to be mathematical modellers. Smith (1996, p. 14) proposed that all people are mathematical modellers to some extent because modelling provides a motivational aspect to the learning of further mathematics. Smith (1996) referred to mathematical modelling as a platform that provides individuals with a systematic way to apply mathematics to the real world or to tackle real-world problems with the aid of mathematics. Though Smith suggests that all people are modellers, his definition does not seem to clearly spell out the difference between the two terms, that is, modelling and application.

Blum and Niss (1991, pp. 42-43) as well as Burington (1995) listed some arguments for including applications and mathematical modelling in mathematics instruction. The five arguments identified by Blum and Niss are (1) a *formative* argument, which states that applications and modelling are a suitable means for developing competency and attitudes; (2) a *critical competency* argument, which states that applications and modelling are there for preparing students to live and act with integrity as private and social citizens with a critical mind; and (3) a *utility* argument, which suggests that mathematics instruction is to prepare students to utilise mathematics in solving problems and to describe aspects of situations. The remaining two include (4) the *picture of mathematics* argument, which argues that an important task of mathematics education is to help students develop a rich and comprehensive picture of mathematics in all its facets, as a science, and as a field of activity in society and culture; and the (5) *promoting mathematics learning* argument, which sees mathematics modelling and application as a means of assisting students in acquiring, understanding and remembering mathematical concepts, notions, methods, and results. Looking at the five arguments and comparing them with the aims of teaching school mathematics in Namibia, it is not clear whether the Namibian mathematics curriculum promotes the picture of mathematics argument which aims to equip students with a comprehensive picture of mathematics, as a science, and as a field of activity in society and culture.

2.4 Potentials, limitations and tensions associated with incorporating the everyday in the mathematics classroom

In this section, potentials associated with incorporating the everyday in the mathematics classroom are summarised and discussed, as well as limitations and tensions that might arise. As some of these are elaborated by the foregoing studies reviewed, there will be overlapping sources. The aim is not to encourage repetition but to show how some of the studies are sympathetic towards the notion of a school mathematics which incorporates the everyday, while others question the pedagogic benefit of such incorporation.

As indicated above, the idea of the academic-everyday relationship in a mathematics classroom is approached from different perspectives. In this section, extensive use of different points of view and the way in which these perspectives relate with the idea of incorporating the everyday into mathematics are provided. However, the researcher is also not claiming that she has conducted a comparative analysis of these perspectives at the theoretical level. This is because she did not explicitly pinpoint their specific ontological and/or epistemological differences, and she did not position each of these perspectives in terms of learning theories. Studies cited below draw from a variety of empirical data and theoretical bases. Highlights presented in this section came from studies which analyse recontextualisation processes, explore ‘word problems’, compare school and out-of-school experiences, or question the feasibility of mathematical modelling.

2.4.1 Potentials of incorporating the everyday

Justifications for recruiting ‘realistic contexts’ or ‘real-world problems’ in the mathematics classroom include motivation, facilitation of meaning-making, and as scaffolds for mathematical concepts, providing a life-like experience. All these are summarised below, based on a selection of exemplary references.

Motivational aspect: Gravemeijer and Doorman (1999, p. 111) indicated that context problems are endorsed because of their presumed motivational power. They assumed that non-mathematical contexts play a major role in the learning of mathematics, especially as nowadays there is an emphasis on demonstrating the usefulness of what is learnt. They declared that ‘context problems can function as anchoring points for the reinvention of mathematics by the students’ (p. 111). The motivational aspect is confirmed by other scholars. Cooper and Dunne (2000a, p. 2) noted, “children will find mathematics more interesting and relevant to their concerns if techniques of calculations are taught in the context of consumption, work, or at least via textual representation of such contexts". Similarly, Lubienski (2000, p. 454) contended that 'cantering mathematics instruction around problem-solving can help all students learn key concepts and skills within motivating contexts'.

Facilitating meaning-making: A study by Kent (2000) which used contexts in a culturally diverse elementary school concluded that all students are capable of learning significant concepts when they have the opportunity to explore ideas in meaningful contexts. Wiliam (1997) stated that both published materials for teaching and learning in mathematics use contexts in mathematics classrooms based on 'real life' in order to make the tasks more relevant to learners. He maintained that both contexts and metaphors are utilised in mathematics classrooms in order to make the mathematical ideas more meaningful. Wiliam provides an example of a task embedded in a context from the Mathematics for the Majority Continuation Project, a project that was aimed at providing learning materials for non-academic pupils who were forced to remain at school through the raising of the school-leaving age to 16. Essentially, the game was a drill-and-practice exercise that 'encouraged students to remember that when a 2-dimensional column vector is used to represent displacement in the plane, the upper number is the displacement to the left (negative) or right (positive), and the lower number is the displacement up or down, although in the game, the lower numbers are all positive' (Wiliam, 1997, p. 10).

Likewise, Sullivan et al. (2003) noted that 'contexts are used frequently in mathematics classrooms in order to make concepts and operations more meaningful, in addition to showing the usefulness of specific ideas and skills being studied'. Similarly, it is assumed that instead of having students complete meaningless exercises, students should learn key mathematical ideas while solving interesting problems (Lubienski, 2000). Particularly for primary classes, Van den Heuvel-Panhuizen (2012, p. 3) proposed ideas such as those contained in stories, and pictures can offer children rich contexts in which they can encounter mathematics-related problems, situations and phenomena which make sense to them. These 'rich contexts' help develop a first understanding of elementary mathematical structures (Van den Heuvel-Panhuizen, 2012, p. 4). Also, Carraher and Schliemann (2002, p. 149) posited that everyday situations in a mathematics class can "provide foundations on which students can quickly erect, with scaffolding supplied by teachers". In their analysis of the oral mathematics used by Brazilian third graders, Carraher, Carraher, and Schliemann (1987, p. 83) found that children are more successful at solving word problems than mental computations, and that "concrete problem situations are powerful elicitors of oral computation procedures". Meyer et al. (2001, p. 526) also noted that when contexts are used in mathematics instruction, they "can sometimes provide students with a model to help them understand as well as remember new mathematics".

Providing life-like experience: Carraher and Schliemann (2002, p. 138) assumed that "highly contextualised problems are believed to provide the students with a richer, more lifelike set of experiences". They admitted that proponents would favour the word problem with the school store approach over the context-free, artificial problem, denuded of a meaningful context (p. 138). Carraher and Schliemann revealed the common claim that contextualised problems (such as 'I had 17 sweets and gave away six of them. How many remained?') are inherently richer than decontextualised ones (17-6 = 11). Further, proponents submit that if a teacher were to stage a commercial transaction in the classroom, with some students acting as sellers and others as buyers, students could immerse themselves even more deeply in the problem. Carraher and Schliemann (2002, p. 133) also proposed, "specific cultural activities such as buying and selling promote the development of mathematical ideas that were previously thought to be acquired only through formal instruction". They noted that everyday mathematics research has repeatedly produced evidence that people learn mathematics outside school settings, and that these out-of-school cultural activities are often recruited as contexts in mathematics lessons.

2.4.2 Limitations and tensions associated with incorporating the everyday

2.4.2.1 Limitations to perceived 'realness' of everyday contexts

The role of 'realistic contexts' is questioned in different ways. Boaler (1993), for example, asked if they really make mathematics sound real. Boaler used a number of examples to demonstrate the extent to which a task context could be real, sound real, or not. She argued that even if at times an activity may be engaging and allow personal understanding to the extent that a student is able to determine her own route through the task, it is unlikely that meaning can be achieved, and such a task might not lead to transfer. Boaler substantiated her claim with an example in which a 12-litre bucket containing two-thirds of water was used. Students were expected to work out the number of litres remaining (how much is two-thirds of 12 litres).

Again, using an example, Wiliam (1990, p. 30) and Wiliam (1997, p. 15) respectively presented the following task:

> *Imagine a city whose streets form a square grid, the side of each square being l00m. A policeman stands at a street-corner. He can spot a suspicious person at*

> *l00m, so he can watch 400m of street. A single block needs 2* policemen *to watch it. 2 blocks will need 3 policemen. What about 3 blocks in a row? 4 blocks in a row? and so on.*

In the aforementioned task, students were required to work out the minimum number of police officers needed for different-sized grids, and they were to produce a model like the one presented below.

Figure 2: Model of minimum number of police officers needed for different-sized grids

This task was considered as accessible and engaging for students for a number of reasons. It is both universally and commonly shared by students (Wiliam, 1997, p. 15). It is based on what students know and are familiar with (i.e. the police officers patrolling or guarding city streets). Despite these benefits, the task was criticised. It was contended that although “this task requires students to enter into a fantasy world in which all policemen see in discrete units of 100m … for many students, the idea that someone can see 100 metres but not 110 metres is plainly absurd” (Wiliam, 1990, p. 30). Contexts of that nature may be recruited by mathematics teachers in Namibia.

2.4.2.2 Students assume the irrelevance of everyday knowledge

Possibly based on experiencing such tasks as described above, some children might come to believe that real-world knowledge is irrelevant for solving school mathematics tasks. In responding to mathematical word problems, De Corte (2000) observed that some of the school children believe that real-world knowledge is irrelevant. In one of the studies involving items drawn from the real world, one learner expressed his or her opinion this way, “Maths is not about things like that [real-life aspects]. It’s about getting sums right and you don’t need to know outside things to get the sums right” (De Corte, 2000, p. 37). Consequently, analyses of word problems led to an argument that the stereotypical nature of some school word problems can make students not relate to what they learn to real life (Nesher, 1980). Criticism of the artificial and unrealistic nature of textbook word problems has indeed pointed out that this might be the reason for the students’ suspension of realistic considerations, even when more realistic problems are presented (Gellert & Jablonka, 2009, p. 41). Nesher (1980, p. 41) provided evidence of the tendency of some children to “engage in activities of solving word problems without relating them to any real-life experiences”. Instead of serving their purpose, Nesher maintained that word problems were perceived by students as part of the school ritual. In Nesher's examples, first and second graders were asked to tell a "story" which would correspond to the mathematical sentence 1 + 6 = 7. Johnny (second grade) wrote, "Mummy bought an iron and then she bought six more irons. Now she has seven irons". Nesher argued that obviously, this story does not represent an elaboration of a real-life situation but rather Johnny's school experience concerning task requirements. Nesher added that the student was just given some numbers and was asked to do something with them. To the student, it did not really matter what he did as long as he responded promptly to the teacher's request. In a similar incident, another student (first grade) was asked to compose a story for the numerical expression "3 + 4". She said, "I ate three cups and four plates ...". Nesher posited that this student too was more concerned with fulfilling her respondent role than monitoring the plausibility of her story. Nesher further asserted that such incidents characterise part of school learning because they could not have been learnt in children's real-life experiences. These examples demonstrate why it is necessary to investigate what happens in the mathematics classroom.

A glimpse at the history of mathematics education reveals that 'word problems' have existed in teaching materials for a long time. Swetz (2009, p. 73) attested, "some of the earlier communication consisted of word problems". In many cases, these were merely artificial disguises or excuses for applying a certain mathematical technique (Arcavi, 2002, pp. 20-21). In an attempt to raise awareness about the problems of recontextualisation, Gellert and Jablonka (2009) also illustrated dilemmas faced by both teachers and students when confronted with contextualised tasks. Gellert and Jablonka (2009, p. 42) discussed tensions regarding the recruitment of the everyday in mathematics and argued that these difficulties are related to the ways in which the process of recontextualisation operates in the classroom. They warned that such a tension cannot be easily resolved by attempting to make word problems more authentic or by interpreting them as problems of mathematical modelling.

Also hinting at the complexity involving academic-everyday relationships, Carraher and Schliemann (2002, p. 151) revealed, "a buying-and-selling situation set up in a classroom is a stage on which a new drama unfolds". A recruited shopping context is not the same as before because once recontextualised, it would have "redefined the acts, settings, agents, tools, and purposes" (Carraher & Schliemann, 2002, p. 151). Cooking, baking, and farming are similar activities which teachers usually recruit. Another lesson that might be learnt here is that contexts recruited in the mathematics classroom do not necessarily remain the same as would be in their actual settings. More radically doubting the usefulness of contexts, Lave (1988) alleged that in school, some recruited everyday situations such as shopping serves only to disguise mathematical relations. Similarly, Boaler (1993) stated that many school mathematics tasks are covered by ‘real’-life contexts, where learners are required to engage partly as though a task were real while simultaneously ignoring factors that would be important. Cooper (1992, p. 234) and Cooper and Dunne (1997) made a similar observation regarding an examination question that required students to work out the number of times a lift which can carry a maximum of 14 people would have to go up (and down) in order to carry 269 people to the top floor. It is argued that such a question ignores some real-life issues. Among those real-life issues is the fact that some people might choose to use the stairs rather than wait for the lift. In addition, they questioned the suitability of the simple mathematical model suggested in the correct solution given. From these examples, there arises the possibility for students to assume the irrelevance of the everyday in mathematics.

2.4.2.3 Contexts might evoke sensitive experiences and alienate some students

Concerned with relevance, appropriateness, purpose, and sensitivity of some contexts, Sullivan, Zevenbergen, and Mousley (2002) questioned if some of the contexts are snakes that deter or ladders meant to facilitate students learning. Sullivan et al. (2002) warned that a more cautious use of realistic contexts is necessary. Educators in their study cautioned that recruiting contexts such as police arrests and jail terms could be sensitive topics for students whose family members were involved in similar or parallel cases. Furthermore, Sullivan et al. postulated that if contexts are not used carefully, they have the potential to restrict the mathematical development of some students (Zevenbergen, Sullivan, & Mousley, 2002, p. 650). They raised the need for awareness of these potential problems. Hence deciding about the suitability of contexts for a whole class is complex, as there can be alienation and bias and “decisions on the suitability of contexts are also complex and multidimensional” (Sullivan et al., 2003, p. 107). Sullivan et al. added that the way the task contexts are presented as well as the way the tasks are incorporated into classroom routines have the potential to alienate some groups of students. Zevenbergen et al. (2002) also questioned whether contexts are there to include all students or to alienate some of them.

2.4.2.4 Unfamiliar contexts can be problematic

Using unfamiliar contexts to students is like talking about the sea to a frog that has never left its pond. A context used by Kent (2000) can attest to this. While teaching integers, Kent (2000) used an example with a class of fifth-grade students from culturally diverse backgrounds to learn mathematics concepts about operations with integers (addition and subtraction). In her example, Kent wanted students to visualise the process of ships moving from a canal filled with water at one level to a river that has a different water level (Kent, 2000, p. 62). Though this context provided good results, helping students learn concepts of addition and subtraction, other scholars found this context problematic. According to Sullivan et al. (2003, p. 110), this context is problematic in that if students are unfamiliar with river shipping, it cannot be meaningful. Sullivan et al. (2003) maintained that even for students who are familiar with the context, the link to mathematical concepts is somewhat doubtful. According to these educators, 'water depth is not really a suitable model of negative integers, since the negative heights are only negative in a relative sense' (Sullivan et al., 2003, p. 110).

2.4.2.5 Contexts can frustrate students

In a study in which Lubienski (2000) wanted to understand how students of low and higher socio-economic status (SES) experienced a trial curriculum and pedagogy, many students expressed a mixture of opinions about the contextualised tasks. Lower SES students found 'problems frustrating', and they were either 'too confusing or hard' (Lubienski, 2000, p. 246). One of the students expressed her frustration in the following words: 'The books are confusing [because the] questions are too long and complicated' and 'I don't like this math book because it doesn't explain exactly!' (Lubienski, 2000, p. 246). Other students in the same study admitted they were better at mathematics, as it had been taught previously. A student's failure to see benefits from the new programme is expressed in the following words: 'I used to do really good in math ... I'm worse [now]'. Adler (2000, p. 214) stressed that a context that is used as a resource for teaching mathematics can only be beneficial if it does not distract learners from mathematics.

2.4.2.6 Students might not prefer 'realistic contexts'

In a study with primary school pupils, Wiest (2001) investigated the efficacy of different contexts for word problems with year 4 and six children. Problems employed in the two sets had the same mathematical structure and demands on problem-solving skills. Two main categories of fantasy and real-world contexts were derived, and they were subdivided further into *low* and *high* fantasy contexts, and *children's* and *adults'* real-world contexts respectively (Wiest, 2001, p. 78). In this study, Wiest (2001, p. 94) found that students not only expressed interest in the fantasy contexts but solved problems using these contexts better than real-world problems. Furthermore, Wiest found that the context of problems affected a number of aspects. These include the children's interest, attentiveness and willingness to engage with problems, the strategies they used, their effort, their perception of success and actual success, and the extent to which they learnt the intended mathematics.

2.4.2.7 Familiarity with the context can be a barrier

A number of researchers acknowledged that incorporating the everyday in mathematics can derail mathematical goals. Thus, it has been stressed that the issue needs to be treated sensibly (Taylor & Vinjevold, as cited in Sethole, 2004, p. 18). Sethole (2004, p. 20) indicated that in South Africa, for example, a number of scholars expressed discomfort with a teaching approach which favours the inclusion of the everyday in school mathematics. According to Sethole, scholars "suggest that the everyday restricts the students'" scope of vision and exaggerates reliability of "close-to-home experience in the learning of mathematics". This makes it difficult for learners to understand academic disciplines (Sethole, 2004, p. 20). Investigating potential beneficial impacts on students' performance as a result of using realistic contexts, De Bock, Verschaffel, Janssens, Van Dooren, and Claes (2003) also provided discouraging evidence from a study on modelling non-linear geometry problems. Also, Arcavi (2002, p. 25) argued that familiarity with a context does not necessarily make life easier because context familiarity involves the influence of everyday language in learning and understanding school mathematics.

Believing that incorporating the everyday may inhibit access to mathematics, Floden, Buchman, and Schwille (1987) suggested that school mathematics should remain separate from the everyday. They suggest that the everyday limits the student's scope of vision, that it exaggerates reliability and the importance of close-to-home experience in the learning of mathematics, and this makes it difficult for students to understand academic disciplines. This point is illustrated in different studies focusing on students' explanations of division by zero. Tsamir and Sheffer (2000) observed that secondary school students maintained that division by zero results in a number. In their study, students did not appear to notice the irrelevance of the everyday as an explanation for this operation (division by zero).

In a study conducted with Upper Primary school children (10 to 11-year-olds), Cooper and Dunne (2000a, p. 9) indicated that children experienced problems in negotiating boundaries between their everyday and mathematical knowledge. Evidence from interview responses indicates that some test items may cause children to draw inappropriately on their everyday knowledge while formulating their answers. In their attempt to determine how children from different socio-cultural backgrounds approach assessment items which embed 'realistic' contexts, Cooper and Dunne (1998, 2000b) observed that some students tend to make too extensive reference to their everyday knowledge when solving word problems. For example, they found that children aged 10 to 11 from working class backgrounds were considerably more likely to employ everyday knowledge than were children from service class origins (p. 17-18). The main issue here does not only seem to be a dilemma in negotiating blurred boundaries but also the fact that it could be challenging for the teacher to recruit contexts in classrooms with a mixture of students from different cultural backgrounds and social statuses. Jablonka (2009) also brought out that when students work with recontextualised activities, some wonder whether they should make extensive or only little reference to their everyday knowledge.

A study by Cooper (2004, p. 185) provided evidence of bias in the design of assessment tasks. Cooper asserted that children are likely to experience difficulties in reading test designers' intentions because ways in which children read problems are not those apparently intended by test designers. Cooper (2004, p. 183) posited that if assessment tasks are to be equitable for all students, then the mode of assessment in mathematics should not cause children from some socio-cultural backgrounds to display their knowledge and understanding more than children from other backgrounds.

2.4.2.8 Hierarchies between applied and pure mathematics

Concerned with the effects of weakly framed criteria for school mathematics tasks, Jablonka and Gellert (2012, p. 286) postulated that while establishing a relationship to students' everyday knowledge and mathematical literacy are valuable aspects of school mathematics, formal theoretical parts of written mathematics are valued more in tertiary education than in practical or applied mathematics. According to Jablonka and Gellert, this 'issue causes curriculum mismatch between secondary and tertiary mathematics' (Jablonka & Gellert, 2012, p. 286). This finding suggests an important subject for curriculum designers to reflect on, that is, the purpose of teaching mathematics in schools. It is also important to reflect on why mathematics is taught to a specific group of students and where that mathematics is likely to place them in future (e.g. university or vocational centres).

2.5 Conclusion

This chapter highlighted different notions and perspectives, and reviewed a selection of studies that informed the idea of incorporating the everyday into the mathematics classroom. The field is considerably wide. In particular, it emerged that including the everyday might mean using realistic contexts, applying mathematics to assumed real-life situations, developing mathematical models, or motivating students through pointing out the usefulness of mathematics. The debates are inconclusive. One difficulty comes from the diversity of theoretical frameworks, which makes a synthesis of outcomes difficult to achieve. How the incorporation of the everyday shapes, both positively and negatively, what students might learn in the mathematics classroom has been highlighted.

Prior work shows that even though most educators argue for incorporating or drawing on students' everyday knowledge, experience or skills in the mathematics classroom, there is no consensus about the ways in which students should be assisted to make mathematical connections (Sawyer, 2008). This suggests that bridging mathematics and the everyday in the mathematics classroom is an aspiration open to many interpretations. Since there is no universal agreement as to how mathematics teachers could go about bridging academic mathematics and the students' everyday – and the call for doing so is prominent in Namibia – the researcher judged it to be a fruitful area for the investigation of mathematics teachers' practices.

In the next chapter, the analytical frame that is used to analyse the collected data will be presented.

PART III

3 Analytical framing

The preceding chapter reviewed literature relevant to this study. This chapter describes the analytical framing employed to interpret the data and, in particular, to provide an empirically based description of teacher practices bridging the academic and everyday life experience in the mathematics classroom. In Section 3.1, the position taken in the curriculum documents in the light of the proposed analytical framework will be discussed. The researcher's choice of the analytical framing and ways in which bridging the academic and the everyday could be viewed under the lens of recontextualisation will be justified and highlight in Section 3.2. Then, Section 3.3 will briefly highlight Basil Bernstein's views on formal educational knowledge. Specifically, the notion of knowledge classification and framing, and the manner in which the concept of classification could be used to illuminate the analysis will be briefly discussed. Bernstein's concept of recontextualisation will be succinctly outlined, including the influence of this idea not only on the choice of participants for the study but also how it informed an understanding of the organisation of educational activities beyond the mathematics classroom. Section 3.4 will focus on the analysis of the data using elements from Paul Dowling's language of description. Dowling's concept of recontextualisation, classification or institutionalisation will be discussed, and the benefits of drawing on his language of description will be highlighted. It will be illustrated that the use of Dowling's Domains of Actions Scheme [DAS] (1998, 2009) may enable description of teachers' practices, and it will be discussed how it will be used to frame the analysis. The DAS scheme allows a distinction to be drawn between texts that are strongly and weakly classified based on how they are presented during pedagogic interactions between the teacher and students. Finally, Section 3.5 will demonstrate that the notion of Dowling (1998) of mythologising the non-mathematics by school mathematics texts is important in helping mathematics teachers understand ways in which teachers make sense and talk about the pedagogic suggestion of bridging the academic and the everyday in the mathematics classroom.

3.1 Curriculum conception in Namibian government policy documents

Some mathematics educators state that a mathematics education curriculum is the product of a social process, and that this process entails ideological struggles between stakeholders pursuing different goals and interests (Jablonka & Gellert, 2012, p. 286). The outcome of this struggle is a compromise between various social positions and agendas. In line with many curriculum aspirations, the government policy on teaching mathematics in Namibia calls for school mathematics to be taught in a way that develops mathematical thinking and positive attitudes towards mathematics (Ministry of Education, 2010b). Along with the development of attitudes, the document promotes functional numeracy and states that mathematics teaching should enable students to acquire, understand and master basic mathematics concepts, operations, and notations.

As noted in Chapter 1, the curriculum document also advocates that (1) teaching and learning of school mathematics should connect with and draw on students' experiences, and that (2) the teaching and learning of mathematics as a subject should draw on the local context and should enable students to apply mathematics in everyday life (Ministry of Education, 2010b). It is assumed that this might also help to develop positive attitudes. This direction for the mathematics curriculum developed for Upper Primary and Junior Secondary education could be understood in the light of the concepts of insulation and hybridity of Muller and Taylor (1995, p. 257), which draw on the work of Basil Bernstein. These concepts focus on the idea of boundaries, for example, the boundary between school and everyday knowledge, and between discourses. The term insulation suggests impermeability of supposed boundaries, be it boundaries between domains of activities, cultures, textual classification, and also of disciplinary autonomy. Hybridity refers to the permeability of boundaries between classifications. Namibia's mathematics policy documents for Upper Primary and Junior Secondary mathematics appear to show a hybridity tendency. This entails a bridging between the academic and the everyday in the classroom, expressed and promoted in several ways.

The National Curriculum for Basic Education stressed that the development of 'understanding, and the ability to create new knowledge and acquire new skills do not happen in isolation' (Ministry of Basic Education Sport and Culture, 2008, p. 29). The document emphasises the utmost importance of realising that individuals are 'situated in natural and cultural contexts with which they interact, which affects them, and from which they draw upon to construct understanding' (Ministry of Basic Education Sport and Culture, 2008, p. 29). From this understanding, it is believed that 'if students are taught in a way (1) which builds on what they already know and have experienced, and (2) are encouraged to relate new knowledge to the reality around them, they will realise that learning in school can be meaningful' (Ministry of Basic Education Sport and Culture, 2008, p. 29). Students will come to a realisation that mathematics taught in schools can even be useful (Ministry of Education, 2010a, p. 3). All these are reasons to justify the inclusion of everyday experience in Namibian mathematics classrooms.

3.2 Choice and justification of the analytical framing

Since the curriculum suggests that everyday experience should be brought into the mathematics classroom, this conception of school mathematics may be seen as being constructed by a form of recontextualisation of other mathematical and non-mathematical practices and discourses. This suggests drawing on theories of recontextualisation.

3.2.1 Theories on recontextualisation

Dowling (2013a, p. 1) noted three major theories in the field of educational studies concerned with the notion of recontextualisation. These are Bernstein's Pedagogic Device (PD) (Bernstein, 2000), Dowling's Social Activity Method (SAM) (Dowling, 2009) and Yves Chevallard's Theory of Didactic Transposition (TDT) (Chevallard, 1989). These are all complex theories; therefore, their presentation here cannot be comprehensive.

Elements from Bernstein's PD and Dowling's language of description have been chosen for the framing of the study and analysis of the data. Chevallard's TDT was not used for the following reasons:

- The TDT deals with the culture of mathematics education in relation to the culture of mathematics research.
- Although distinctions are made between techniques for solving sets of problems, technology and mathematical theory, the TDT does not specifically deal with differences in the classification of knowledge.

To describe teacher practices of bridging the academic and the everyday in a pedagogic relation informed by the curriculum conception outlined above, an analytical framework is needed which not only enables the description of 'transposed' mathematical knowledge structures achieved by TDT but also captures 'hybrids' between the academic and the everyday.

3.2.2 Capturing recontextualisation in the study

In Dowling's view, 'school mathematics is seen as a special activity' which recontextualises other discourses (Dowling, 1998, p. 288, 2008, 2009). In his language of description derived from an analysis of a textbook series, Dowling formulated a DAS scheme, which enables an understanding of the organisation of school mathematics texts and means through which students might be apprenticed to the domain of mathematics. The DAS scheme is discussed in Section 3.4.3. This scheme is not restricted to monologic texts, but it can also be applied to dialogic texts produced in a pedagogic context. Monologic texts are texts which constitute single authorial voices, while dialogic texts constitute multiple authorial voices (Dowling, 1998). A mathematics textbook is an example of a monologic text, whereas the text produced in a pedagogic relationship in the classroom by a transmitter (a teacher) and an acquirer (students) is a dialogic text. The idea that school mathematics casts a gaze onto, or fetches other activities (Dowling, 1998, 2007, 2008, 2009), is useful in analysing the data generated by the study. Further, Dowling's notion of myths in school mathematics texts may help in determining ways in which teachers and their subject advisors talk about bridging mathematics and students' everyday life, as well as highlight tendencies in the official curriculum documents. Dowling's domains of actions framework may illuminate the sorts of links between mathematics and the everyday that teachers make during their lessons. At the same time, this could provide a bigger picture on what trajectories teachers follow as they bring the everyday on board.

In conceptualising this study, the concept of recontextualisation of Bernstein (2000) is also employed in this study. Bernstein's concept of recontextualisation proposes that discourses undergo transformation as they move between the contexts of production and enactment. His concept of classification gives rise to the idea of categorising knowledge systems. The researcher found Bernstein's distinction between commonsense and uncommonsense knowledge helpful in understanding tensions that surround the incorporation of the everyday into mathematics. His notion of recontextualisation also provided insight on the organisation of educational activities beyond the mathematics classroom setting. Thus, in this study, the researcher pictures the study's respondents as representative of two discrete recontextualising agencies serving in their different recontextualising fields (Bernstein, 2000). The recontextualising agents in this study are school mathematics teachers and mathematics subject advisory teachers (at both national and regional level). The reason for the inclusion of subject advisors is discussed in the methodology chapter.

It is important to emphasise that this study will not be overly framed by Bernstein's framework of Pedagogic Device, neither will it be wholly framed by the organisational language of Dowling (1998, 2009), the SAM – it will draw on elements of both. To provide a wider picture, elements of both theories will be discussed next.

3.3 Bernstein's work on the organisation and classification of knowledge in educational activities

Bernstein (1973) argued that formal educational knowledge is realised through three message systems: curriculum, pedagogy, and evaluation. He maintained that while curriculum defines valid knowledge, pedagogy defines what counts as valid transmission of knowledge. If everyday knowledge is constituted as valid knowledge in a mathematics classroom based on a 'hybrid' curriculum, it is not clear what would constitute valid transmission of this knowledge. Evaluation defines a valid realisation of educational knowledge on the part of the learner (Bernstein, 1973, p. 363). This study will only deal with aspects of classroom pedagogy and will not pay explicit attention to evaluation in assessments.

In regard to the structure and shaping of educational knowledge, Bernstein introduced the concepts of classification and framing. He used the concept of classification to categorise knowledge into two forms: uncommonsense knowledge of the school (which includes mathematics), and the commonsense knowledge – or the everyday community knowledge – of the pupil (Bernstein, 1973, p. 376). He contended that these two are distinct from each other.

3.3.1 Concepts of classification and framing

Bernstein used the concept of classification to describe the degree of permeability between the different disciplinary contexts which make up a formal curriculum and the concept of framing to describe aspects of pedagogy (Bernstein, 1973). In particular, he referred to "the strength of the boundary between what may be transmitted and what may not be transmitted, in the pedagogical relationship" (Bernstein, 1973, p. 366). Dowling (2013a, p. 1) explained that the classification concept implies "regulation between contexts", whereas framing implies "regulation within a context". Bernstein posited that the framing refers 'to the degree of control a teacher or pupils might have over the selection, organisation, and pacing of the knowledge transmitted and received in the pedagogical relationship' (Dowling, 2013a, p. 366).

Bernstein not only used the term ‘classification’ to refer to different forms of knowledge but also to explain how strongly knowledge forms are insulated from each other, as well as how they are distributed to social groups (Bernstein, 1996, 2000a). In Namibian schools, particularly from the Upper Primary to Senior Secondary phase, there are different categories of school subjects which are insulated from one another; mathematics is one of these subjects. Hence, there is strong classification between mathematics and other school subjects. With regard to how knowledge is distributed to social groups, Bernstein (2000a) reiterated that everyday knowledge, knowledge that is mundane or thinkable, is distinct from knowledge that is unusual, strange and allows the ‘unthinkable’, a specialised or esoteric knowledge to be conceived. The thinkable is what Bernstein (1973) termed commonsense knowledge, and this refers to the knowledge that is gained from everyday experience. The unthinkable refers to the knowledge accessed in formal institutions of education such as schools, colleges, and universities.

The manner in which these concepts were used by Bernstein (1973) was not without critique. For example, Cooper (2004) maintained that ‘the discussion of the boundary between educational knowledge and commonsense knowledge made use of a ‘frame’ even though it appears to be a matter of classification’ (Cooper, 2004, p. 2). It appears that the two terms cannot vary independently, as weak framing would also mean weak classification. This would render one of the concepts redundant. Less control over what is to be transmitted or learnt would constitute a weaker specialisation. The question remains, however, as to which comes first – a given classification or the framing that produces it.

3.3.2 Fields of recontextualisation

As outlined above, there is an understanding that a school curriculum entails a recontextualisation process. Bernstein (2000) proposed the existence of a scientific discourse emanating from the field of its production, which is recontextualised into a school subject creating its own discourse. In Bernstein’s vocabulary, the term recontextualisation generally refers to the relocation of a discourse from the field of its production to its relocation as a pedagogic discourse (e.g. its enactment in the classroom).

Bernstein (2000) described how educational activities are organised outside the classroom context. He identified three main fields: knowledge production, recontextualisation, and reproduction. In Bernstein’s conceptualisation, ‘field’ refers to different levels and takes on different meanings: (i) the field of production refers to the sector of symbolic production, and this is, for example, where new mathematics knowledge (theory) is constructed at universities; (ii) the recontextualisation field is the arena of practice in which discourses from the field of production are selected, appropriated and repositioned to become ‘educational’ knowledge; and (iii) the field of reproduction refers to institutions such as schools where pedagogic practice takes place.

The recontextualisation field of Bernstein (2000) is subdivided into subfields: the Official Recontextualisation Field (ORF) and the Pedagogic Recontextualisation Field (PRF). The ORF consists of the official state curriculum itself and those who design or develop it. These include, for example, officials in the departments of education but could also be researchers who are recruited. The PRF is constituted by those who interpret and enact the official curriculum. These include mathematics teachers and other educators. Recontextualisation in the PRF concerns adoption and implementation of Official Pedagogic Discourse (OPD). This adoption and implementation of OPD is the transformation of mathematics discourse into accessible pedagogic forms by teachers in the classroom.

In the ORF, there are education officers (EOs) at the national level and subject advisors (SAs) at regional level. The OPD produced in this field may be in the form of national policy documents such as the state-endorsed curriculum documents. The national curriculum documents and school subject syllabi are part and parcel of the OPD. The adoption and implementation of a specific aspect of the OPD in the PRF into accessible pedagogic forms by teachers in the classroom is the main focus of this study and to determine whether there is a visible connection between these.

3.4 Dowling’s Social Activity Method

3.4.1 Classification and distinction between practices

In his organisational language, Dowling (2009) also made use of the term ‘classification’. While the concept of classification of Bernstein (2000b) refers to boundaries between discourses, Dowling’s classification refers to relations within a discourse itself (Dowling, 2009). In Dowling’s terms, different practices entail different discourses. Since this study looks at recruiting the everyday into the mathematics classroom, Dowling’s notion of classification may enable a better description of teachers’ ways of doing so, as classroom observation means looking from within. This concept of classification, or of institutionalisation (further discussed below), allows the identification of school mathematics texts which are unambiguously mathematical in terms of their form of expression and ‘hybrids’. Mathematics can be recognised by mathematical symbols, which in the classrooms studied might include equations, arithmetical symbols, positive and negative numbers, unknowns (such as those signified by alphabetical letters), and other mathematics terminology such as ‘solve’ and 'calculate'. Dowling (1998, p. 134) contended that a term such as 'solve' can either be interpreted as a mathematical process or not, for example, in the sense of solving a crime. Further, Dowling asserted that school mathematics texts might exhibit "comparatively strong classification or specialisation of mathematical knowledge" (Dowling, 1998, p. 134).

Depending on the topics discussed, it is anticipated in this study that the tasks employed by teachers could take a form of a hybrid. It is also anticipated that teachers might use metaphors or analogies and expect that there will be some school mathematics texts that would point to something outside mathematics, particularly when teachers attempt to include students' everyday experiences. In a case where signifiers are used to point to something else, there would be reduced specialisation either in the form of expression or content of those texts. Dowling (1998) maintained that the reduced specialisation of either form of expression or content signals a weak classification of school mathematical knowledge. In such a case, the content of the task can still be constituted as mathematical; however, it is no longer obvious that the task is about mathematics. In other words, Dowling postulates that specialised contents will be there, but they are no longer as clearly visible or explicit. There will be a reduction in the specialisation or in the extent to which a specialised practice is observable. Dowling (1998) asserted that not only are school mathematics and domestic activities distinct regions of practice, but they are also quite fundamentally different modes of practice.

Another aspect of Dowling's organisational language useful for this study is his view on school mathematics as being a recontextualising activity. Dowling (1998, 2007, 2008, 2009) described school mathematics as a special activity which recontextualises other practices. As part of his organisational language, Dowling (1998, 2009) devised a DAS scheme. The DAS scheme was developed for pedagogic contexts and in relation to school mathematics.

Furthermore, Dowling categorised practices according to the extent to which they make their principles linguistically available. He submitted, "whilst all practices are material, some practices minimise their dependency upon the material via the production of highly developed and articulated, and highly systematised discursive structures" (Dowling, 1998, p. 137). Dowling proposed that some of the practices may not be fully realised in language. He specifically claimed that mathematics is one of those practices that minimise its dependency on the material and produces highly developed, articulated, and systematised discursive structures. This means mathematics is regarded as one subject that can be realised in language and is able to make its principles linguistically available. In his own terms, Dowling asserted that mathematics is an example of a highly discursively saturated practice, and this is because mathematics “is highly organised at the level of discourse and produces generalised utterances” (Dowling, 1998, pp. 103-104).

The extent to which a practice makes its principles linguistically available is termed ‘discursive saturation’ (Dowling, 1998, 2007, 2013a, p. 3). Dowling claimed that there are practices which exhibit low discursive saturation. He described such practices as “context-dependent, since they do not incorporate explicit regulatory principles” (Dowling, 1998, p. 94). Some of the practices which teachers recruit as they bridge school mathematics and the everyday in a mathematics classroom could be categorised as exhibiting low discursive saturation. Domestic and manual practices are identified as examples of low discursive saturation because they “are not generally highly organised at the level of discourse and they produce localised utterances” (Dowling, 1998, pp. 103-104). Highlighting what is meant by ‘local utterance’, Dowling (2003) maintained that utterances of the low discursive saturation type are characterised by implicit regulating principles, are context-specific and are interpreted within the context of a particular activity. Dowling discussed the ideas of discursive saturation in two separate schemes. One scheme displays the Modes of Recontextualisation, whereas the other scheme displays the grammatical modes. Although discursive saturation is mentioned, the analysis in this study will not explicitly attend to the ideas contained in Dowling’s two schemes at this point, but only to the idea contained in the DAS scheme.

The DAS scheme of Dowling (1998) will be sufficient to allow a more differentiated description of ‘classification’ of mathematics texts. With this scheme alone, it is possible to distinguish between the expression in a message (how the text is tuned via signifiers) and what the text’s message is taken to refer to (the signified or content). Concerning the DAS scheme, one earlier version of this scheme uses classification, while the other scheme employed the term ‘institutionalisation’. Both are discussed in Section 3.4.3.

As this study intends to set apart various categories of relations between everyday knowledge and academic mathematical knowledge in their development in classroom interaction, Dowling’s DAS model not only sheds light on how teachers could bridge mathematics and the everyday but also enables an understanding of the organisation and categorisation of mathematics text (both written and spoken) and can highlight different trajectories teachers could assume as they help their students access abstract mathematics knowledge (see Section 3.4.3.4).

3.4.2 Recontextualisation

Dowling also made use of the term recontextualisation. In his articulation of the term, he (Dowling, 2013a, p. 1) maintained that the term "refers to the contention that texts and practices are transformed as they are moved between contexts of their reading or enactment". To discuss this further, it is useful to summarise three characteristics through which Dowling viewed school mathematics.

3.4.2.1 School mathematics as an activity

Dowling (1998, p. 21) postulated that society comprises relations and practices which are organised as empirically definable activities. An activity is defined as "a structure of relations and practices which regulates who can say or do what" (Dowling, 1998, p. 21). Specifically, he identified school mathematics as an empirically definable activity. In this study, the researcher has investigated school mathematics activities where there are teachers who teach students and learners who are being taught, who are expected to carry out certain duties assigned by the teacher or by policy documents. Dowling added that activities are produced and reproduced by human subjects who move routinely between activities and by texts (Dowling, 1998, p. 21).

3.4.2.2 Academic mathematics as an explicitly principled and self-referential practice

Dowling (2008, p. 21) described academic mathematics as an "explicitly principled and self-referential" practice. Constituted as being self-referential academic mathematics does not necessarily refer to anything outside itself but is concerned with its own development. Reference to anything outside might be made with the purpose of introducing learners to the domain of mathematics, facilitating their access to the esoteric domain of the practice, motivating students, and facilitating sense-making in that subject. Three out of the four domains contained in the DAS scheme (discussed below) indicate such reference. Employing the scheme could provide insight into what it is that teachers are trying to achieve.

Furthermore, Dowling maintained that mathematics "exhibits a highly explicit grammar in respect of what can count as a mathematical utterance and what can count as a true mathematical utterance" (Dowling, 1998, p. 3). When students are taught mathematics, they might be required to learn the principles of the practice and also to provide what counts as legitimate answers. As Dowling (2008) conceives the principles as culturally arbitrary, he noted that students may not be able to arrive at them on their own. This explains the significant role of the teacher as far as incorporating the everyday in mathematics is concerned.

3.4.2.3 School mathematics as a recontextualising activity

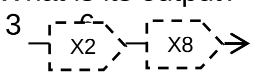
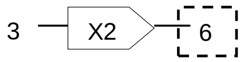
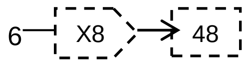
Dowling (Dowling, 1998, p. 136, 2007, 2009, 2010) suggested that for their reproduction, all activities need apprentices. Apprenticeship is a form of relationship in which there is an interaction between an adept (expert or skilled person such as a teacher) and a novice (such as a learner) (Dowling, 1998, p. 29). Creating an apprenticeship can be taken to imply that if a teacher has to introduce students to advanced mathematics, then the teacher might need to find modes of addressing his or her students in a language that is accessible to them. This explains why there are weakly specialised texts during mathematics instruction. The teacher has to seek ways in which they relate mathematics concepts and procedures to those of non-mathematics activities. Dowling (1998, p. 15, 2009) further suggested that school mathematics as an activity can be empirically described as exhibiting a particular structure of social relations. This structure will thus tend to subordinate to its own principles any practice that is recruited by it (Dowling, 1998, p. 25). Dowling called this the principle of recontextualisation.

During mathematics instruction, when school mathematics teachers recruit other practices for pedagogic reasons, mathematics is said to be casting a gaze onto them. Dowling (2010, 2013b, p. 325) described the gaze in mathematics education as the ‘fetching’ of/on other practices. School mathematics fetches on other practices, recontextualises them as mathematical practice, hence subjecting them to its own principles. In this way, school mathematics is said to be casting its eyes beyond itself. In other words, the deployment of principles that are specific to school mathematics result in the recontextualisation of other activities as mathematised activities. This constitutes school mathematics as a recontexualising activity (Dowling, 1998, p. 15).

3.4.3 The DAS scheme and processes of recontextualisation

As discussed above, for pedagogic reasons, there is a need for school mathematics texts to recruit non-mathematical settings (such as everyday domestic settings). It is observed that when the everyday is recruited, the structure of the resulting tasks tends to prioritise mathematical principles rather than favouring the principles of the recontextualised practice (Dowling, 1998). Since the term recontextualisation refers to the contention that texts and practices are transformed as they are moved between contexts of their reading or enactment (Dowling, 2013a, p. 1), this articulation can also be interpreted as suggesting that there must exist a possibility for (mis)interpretation as the school curriculum moves between contexts of production and enactment. To elucidate how the mathematics gaze operates, as well as explain ways in which an apprentice (which is a student in this case) might be introduced to the domain of mathematics and its principles, Dowling (1998, pp. 133-134, 2009) derived a 2-by-2 grid displayed in the Tables 1 and 2. This scheme is based on the distinction between signifiers and what is signified.

Table 1: Domains of actions

<table>
<tr><td colspan="2" rowspan="2"></td><td colspan="2">Content (signified)</td></tr>
<tr><td>Strong classification</td><td>Weak classification</td></tr>
<tr><td rowspan="2">Expression (signifier)</td><td>Strong classification</td><td>Esoteric domain
E.g. Solve for:
(a) 18x + 92 = 137
(b) 0.7x + 3.2 = 4.88
(c) 2.9x - 3.5 = 19.7
(d) 0.4x - 4.6x - 4.6 = -2.0</td><td>Descriptive domain
E.g. A café orders p white loaves and q brown loaves everyday for r days. What does the expression tell you? (a) p + q, (b) pr, (c) qr, (d) (p + q)r</td></tr>
<tr><td>Weak classification</td><td>Expressive domain
E.g. Here is a machine chain. What is its output?

You find the output from the first machine …

And you put in the second machine.
</td><td>Public domain

E.g. What is the bill for buying for each of the following lists?

(a) 1kg of potatoes, 1 grapefruit
(b) 2 oranges, 1 cauli
(c) 2kg spuds
(d) 1kg bananas
100g mushrooms
1kg bananas
(e) 1 grapefruit
1 orange</td></tr>
</table>

Source: Adapted from Dowling (1998, p. 133)

Further development led to a modified scheme presented in Table 2.

Table 2: Modified scheme of the Domains of actions

<table>
<tr><td colspan="2" rowspan="2"></td><td colspan="2">Content (signifieds)</td></tr>
<tr><td>I+</td><td>I-</td></tr>
<tr><td rowspan="2">Expression (signifier)</td><td>I+</td><td>Esoteric</td><td>Descriptive</td></tr>
<tr><td>I-</td><td>Expressive</td><td>Public</td></tr>
</table>

Source: Adapted from Dowling (2007, 2009)

What has been modified in Table 2 is the term 'classification', which has been replaced by the term institutionalisation (signified by I). As in the earlier version, there is a distinction in terms of strength (in Table 2, strong is indicated by '+' and weak by '-'). Both of these are discussed below. The concepts displayed in both tables suggest a range of strategies that could be deployed in terms of mathematics teaching and analysing mathematics. Both schemes (Tables 1 and 2) display four domains of actions that constitute school mathematics texts: Esoteric, Descriptive, Expressive, and Public Domain. In both schemes, the modes of expression and content are distinguished. These categories suggest that in a written or spoken text, one can look at the manner in which text is tuned or organised. This can be in terms of the nature of the metaphors used or contexts fetched (signifiers) and determining to what practices these refer (signified). Dowling (1998, p. 98) noted that the meaning is created at the fusing of the signified and signifier. Connecting a signifier and a signified produces a sign that communicates a certain meaning.

While Bernstein's concept of classification referred to the strength of the insulation between categories, Dowling (1998, p. 116) suggested that the term classification can be used to measure the degree of specialisation of any social category. This suggests that Dowling's term of classification (Table 1) can be used to mark the level of specialisation in mathematics texts (i.e. how weak or strong it is) as it compares with others. Dowling (1998, p. 117) noted that some 'text' may indicate strong classification of mathematics with respect to other discourses. He added that it is also possible to present a text that indicates strong classification in an alternative form which weakens the classification (Dowling, 1998, p. 118). When the everyday is recruited in mathematics texts, this results in a weakening of classification of that particular text.

3.4.3.1 The modification of the DAS scheme

Dowling (2007) distinguished the four domains in terms of the level of institutionalisation of the content and expression of a text (Table 2). Dowling maintained that the form of expression and nature of the content can be measured separately either in terms of strength of classification (Dowling, 1998) or in terms of the degree of institutionalisation (Dowling, 2007, 2009). The reason for switching from the use of classification to institutionalisation is discussed below.

Dowling (2007, p. 4) observed that a category such as that defined by the term 'classification' does very little to define empirical texts. In addition to the first DAS scheme, Dowling introduced another "organisational scheme for describing the strategies that are involved in one discourse describing another" (Dowling, 2009, p. 205). He "established four domains of practice by distinguishing the level of institutionalisation of the content and expression of a text or textual fragment" (Dowling, 2007, p. 5). Taking into consideration that texts relate to practices, Dowling "made an analytic distinction between expressions (signifiers) and contents (signified), considering each in terms of the level of institutionalisation of the text" (Dowling, 2009, p. 205). He proposed, "one can quite easily distinguish between text that deploys exclusively technical mathematical signs and text deploying signs where the expression and content are arbitrary with respect to mathematics" (Dowling, 2007, p. 6). Dowling (2009, p. 205) anticipated that there would be strings in mathematics texts that would "consists of strongly institutionalised expressions (such as algebraic, logical symbols) and contents (i.e. what these symbols and texts mean in the contexts of mathematical texts)".

Furthermore, Dowling anticipated that texts/expressions which are strongly institutionalised might end up being decoded. Further, Dowling maintained that some versions of the decoded expressions can still contain strongly institutionalised content. For example, in the expression x = 2 (where x is the number of hens in a coop), part of this expression is constituted as having strongly institutionalised content (i.e. x = 2). Dowling argued that this decoded version can still contain a strongly institutionalised content even though the strength of institutionalisation in the text is weakened. The strength of institutionalisation in that text is weakened a little because some of the formal language has been replaced by natural language (Dowling, 2009, p. 205).

Referring to the same expression of x = 2 (where x is the number of hens in a coop), Dowling contended that even though the first part of the expression retained a strongly institutionalised expression, x = 2 does not refer to a mathematical object. The expression x = 2 refers to a non-mathematical object, as it refers to the hens. On the contrary, Dowling maintains that if the statement is expressed as 'there are two hens in that coop', then in this way, the expression can be seen as having lost its status of being a strongly institutionalised mathematics expression.

Dowling (2009, p. 206) posited that inasmuch as pure mathematics does not constitute 'empirical referents' (i.e. does not refer to any non-mathematical objects), those texts have to be confined to the left-hand side of Table 2 (i.e. in the esoteric domain, and if these are expressed through non-mathematical signifiers, in the expressive domain). He also proposed that school mathematics recruits to its esoteric domain other activities, and these activities are used in the mathematising of the world. This mathematising creates the descriptive and the public domain. In this way, school mathematics is constituted as having empirical referents because it does refer to something else. The texts with empirical referents have to be confined to the right-hand side of Table 2 (i.e. in the descriptive or the public domain).

3.4.3.2 Institutionalisation

Dowling (2007, pp. 5-6) defined institutionalisation as a “regularity of practice emergent on autopoietic action”. The term refers to an ‘identifiable regularity of practice that is able to reproduce and maintain itself’ (Dowling, 2007, p. 5). He proposed that in any activity, if there is a pattern of how things are done, then one could say there is some degree of institutionalisation. He acknowledged that a ‘substantial body of mathematical practice can be described as strongly institutionalised’ (Dowling, 2013b, p. 324). The symbol I+ is used to signify strong institutionalisation, whereas the symbol I- is used to signify weak institutionalisation (Table 2). The two symbols mark the degree of institutionalisation of school mathematics texts, and this means that mathematics texts can be marked as to whether they are regularly identifiable in respect of their expressions and contents.

School mathematics texts may deploy school mathematical technical terms, metaphors, specific terminologies, and mathematical notations. The contents of these texts (what is referred to) may be mathematical objects and processes or something arbitrary to mathematics. Dowling (1998) pointed to school mathematics texts where one may easily distinguish between texts which deploy exclusively technical mathematical signs and texts where the expression and content are arbitrary to mathematics.

3.4.3.3 Elaboration of the domains of actions

Dowling (2007, 2009) named the region of explicitly mathematics texts the esoteric domain (see Table 2). The esoteric domain is the exclusive domain of strongly institutionalised expression and content. It is only within this domain that the principles of mathematics can be fully elaborated or expressed (Dowling, 2007, 2009). Texts that fall under this category communicate their information in an ‘unambiguously mathematical’ fashion (Dowling, 1998, p. 135). Dowling (1998, 2009, 2013) described the public domain as the product of a gaze cast by the esoteric domain action beyond strongly institutionalised mathematics, usually recontextualising non-mathematical practices such as shopping and organising it in conformity with its own principles. One of the researchers who employed the same scheme in her research articulated that usually “such texts (public domain texts) appear when students are to practise applications of a previously acquired method, or when new knowledge is to be derived, based on mathematisation of non-mathematical phenomena” (Mutemba, 2012, p. 26). In the same manner, one would also expect the public domain of action to be the platform where the teacher fetches in other practices in order to introduce his or her students to the esoteric domain of school mathematics. Unlike the descriptive mode of action discussed next, the mode of activities in the public would have a weak institutionalisation, both in terms of their expression and content.

Dowling (2007, p. 6) defined the descriptive domain as the region of mathematical modelling. This is where a text uses strongly institutionalised mathematical language, but the contents are weakly institutionalised. Using the example presented in Table 1, in its vocabulary, the text made use of a signifier such as p+q, which is clearly recognisable as mathematical. However, its content (i.e. what is signified or what is being referred to), its principal denotations (i.e. their meanings), is non-mathematical. The expression p + q refers to the total sum of loaves of bread (brown and white) ordered in a day.

The fourth is the expressive domain text (Table 1, Table 2). Dowling (2007, 2009) asserted that the expressive domain is the opposite of descriptive domain, and this usually becomes a case when a non-mathematical signifier is employed to signify a mathematical object. For example, Dowling (2007, p. 6) explained that in school mathematics, a cake may be sliced, and its pieces may be used to signify the school mathematical concept of a fraction (a piece is a fraction of the whole). Similarly, a balance scale may be used so signify an equation. This means that the expressive domain is constituted as the domain of metaphors or analogies, which are used to signify mathematical aspects. In the example in Table 1, the word 'machine' is embedded in a mathematical context and was used as a metaphor to signify an operator. The key aspect of the DAS scheme is the link to apprenticeship. This means that learners are hailed into mathematical activity through the public domain and led into the esoteric domain via metaphors and analogies of the expressive domain and the possibility of 'applications' in the form of descriptive domain. It is, however, only through access to the esoteric domain that mastery (and hence successful apprenticeship) becomes possible. This is the pedagogic implication of the DAS scheme.

3.4.3.4 Domains of actions as trajectories for mathematics teaching

The three domains (public, expressive, and descriptive) could also be interpreted as alternative routes a mathematics teacher could employ to introduce learners to the esoteric domain of mathematics. Dowling (1998) submitted that the public domain is a crucial component of the practices of mathematics activity because it is the domain through which apprentices must enter the activity (which is the mathematics activity, in this case). Dowling explained that the public domain is the arena in which the recontextualising gaze produces a domain of practices which exhibits comparatively weak classification of text in terms of both its forms of expression and content. It has the form of a non-specialised practice that usually derives from domestic activities that are subjected to mathematical interpretations such as arithmetic calculations. Dowling further cautioned that the regulative principles of the esoteric domain cannot be fully expressed within the public domain, but also not within the expressive or the descriptive domain (Dowling, 1998, pp. 126-127).

While a non-mathematical element can be recontextualised within mathematical practice with the purpose of giving expression to a mathematical content (expressive trajectory) and a non-specialised setting can be recontextualised so that its contents can be redescribed by means of mathematical forms of expressions (descriptive trajectory), Dowling argued that within those domains of action (particularly the public and expressive), there can be no certainty of the prioritising of specialised denotations and connotations (Dowling, 1998, p. 136). However, Dowling contented that locating instruction in the public domain, moving to the esoteric via the expressive as a bridge and enabling the possibility of then shifting to the descriptive gives perhaps the best opportunity to students for apprenticeship into school mathematics. Dowling's proposal or suggestion appears to provide a suitable background for the findings represented in Figures 8 and 9, which suggest that most teachers moved either from the public directly to the esoteric or moved from the public to the expressive without shifting to the descriptive domain.

3.5 Mythologising the non-mathematical by school mathematics texts

Dowling raised the argument that there exists a relationship between school mathematics and other practices, and this relationship gives rise to mythology (Dowling, 1998, p. 2). This mythology is an outcome and a consequence of "particular forms of realisation between the mathematical and other practices" (Dowling, 1998, p. 2). Particular ways in which mathematics and other practices relate produce a range of myths. Dowling (1998) envisioned mathematics as a mythologising activity (Dowling, 1998, p. 2), and this constitutes another characteristic which makes Dowling's notion of mythology a powerful language for describing the relationship between mathematics and the everyday.

Dowling (1996, 1998) identified six myths circulated in school mathematics texts. These are the myth of participation, myth of reference, myth of emancipation, myth of construction, myth of certainty, and the myth of cyberspace. These six myths may be useful for the analysis and discussion of interview or classroom data. Dowling (1998, p. xiv) further postulated that the first three myths are 'dominant' and often under-recognised. Exposing them constitutes another feature of Dowling's language of description (Dowling, 1998, p. 3).

Although myths do not reveal anything about 'intentions' of authors, the researcher argues in this study that mythologising has the potential to reveal perceptions on mathematics, as well as the regularities that may be associated with their school mathematical practice. The six myths are further discussed below.

(i) The myth of participation

Dowling (1988, p. 22) asserted that the myth of participation 'constructs mathematics as a reservoir of use-values with multiple purposes', and its purpose is 'to achieve a unification' of two or more domains of practices or activities. This type of myth is commonly circulated via the use of narratives of mathematics texts such as word problems. For example, an incident of a person acting in a practical everyday situation might be used as an introduction into the esoteric domain of mathematics. This approach supports the perception that everyday practical knowledge is constitutive of mathematical knowledge (Gellert & Jablonka, 2009).

While this type of myth encourages individuals to believe that mathematics is an operational tool to be utilised in other diverse practices (Dowling, 1998), Dowling himself did not deny the potential use-values of mathematics; rather, he questioned what he calls mythologising of non-mathematics activities via school mathematics texts (Dowling, 2001). Although non-mathematics contexts are used as a springboard to esoteric mathematics, some mathematics teachers contended that using domestic activities as a route into mathematics and at the same time restricting its application to those domestic activities entails a myth of participation (Gellert & Jablonka, 2009). This is because mathematical knowledge is construed as a condition for successful participation in non-mathematics activities (e.g. domestic ones). Dowling (2001) stressed that the myth of participation proposes that mathematics is a necessary feature of everyday practices (such as shopping and other domestic activities). The myth of participation relates to practices that engage and remain primarily in the public domain.

(ii) The myth of reference

Another message circulated through school mathematics is the myth of reference. This message suggests that mathematics is a system of exchange-values which can be exchanged for non-mathematical activities. This myth constructs mathematics as a distinctive practice (in contrast to the myth of participation), but whose values can be exchanged for other practices (Dowling, 1998). Here mathematics is not only perceived as having universal descriptive power to describe other activities, but it is also constituted as a necessary ingredient that optimises other activities. In school mathematics, messages of this nature are distributed through problem-solving activities that are constructed mathematically, but a 'trace element' of non-mathematical significations has remained evident. Usually, this feature makes it almost impossible for the learner to evaluate the solution of the problems from a practical point of view (Dowling, 1998, p. 16; Gellert & Jablonka, 2009).

While this myth recognises mathematics as an activity different to non-mathematical activities (academic and everyday), the "recipients of this message are expected to believe that behaving mathematically in everyday non-academic situations would be in their own interests" (Dowling, 1998; Gellert & Jablonka, 2009, p. 43). This type of myth is commonly disseminated under the label of mathematics applications. What appears to be an advantage for mathematics as an activity is that this myth speaks the voice of mathematics – it does not allow other recruited activities to speak for themselves. Mathematics not only disadvantages but also dominates other activities it appears to describe. Dowling (1998) stated that this myth has a tendency to encourage individuals to believe that mathematics is superior to other activities (such as domestic ones) and therefore mathematics always stands as an unavoidable lens through which other activities can be understood. This myth is propagated specifically by those who have access to the esoteric domain of action and therefore are able to cast a gaze over non-mathematical practices.

(iii) The myth of emancipation

The third message is the myth of emancipation. The myth of emancipation, as Dowling (1998) argued, corresponds to the myth of participation because it constitutes the socio-cultural as a unified space. He maintained that the myth of emancipation achieves this in two stages. First, the myth initially establishes the dual space of esoteric and public domain mathematics. Second, it proceeds by declaring that these practices (mathematics and the everyday cultural activities) are the same (Dowling, 1998, p. 294). This myth is commonly expressed in texts which celebrate the pre-existence of mathematical content in other cultural activities (Dowling, 1998, p. 12). According to Dowling, unlike the previous two, this myth does not pathologise the unschooled, but instead it celebrates the mathematical ideas that are 'frozen' in cultural activities (Dowling, 1998).

Proponents of this concept believe that by defrosting the frozen mathematical thinking, one stimulates reflection on crucial social issues such as the impact of colonialism, historical, political, and perhaps cultural dimensions of mathematics (Gerdes, 1988b, p. 152). The message extended to its recipient suggests that by equipping students with mathematics skills, this could foster them to develop critical thinking and cultural confidence (Gerdes, 1988) by unlocking values inherent in their own culture.

Dowling (1998) posited that reflecting on the impact of colonialism in order to develop critical thinking is a valuable goal. However, through the myth of emancipation, it appears that European mathematics is a necessary precondition to reveal to African students the value inherent in their own cultures because such reflection and descriptions are made in European mathematical terms. Dowling stressed that it seems that other cultures or their activities are not being allowed to speak for themselves.

Dowling (1998) contended that the messages are myths insofar as mathematics as a whole is signifying something at a higher level than the processes of signification in mathematical activity. Employing mathematics for other activities also conceals the fact that mathematics deals with general solution methods, which do not take into account contextual peculiarities (Gellert & Jablonka, 2009).

(iv) The myth of construction

The myth of construction conceives “mathematical knowledge as originating in the physical world and acquirable through physical engagement with this world” (Dowling, 1998, p. 289). This empiricist epistemology, as Dowling (1998) argued, “constitutes a denial of the subjectivity of the acquirer/constructor” (p. 289), referring to the work of Jean Piaget as an example that depicts this type of myth. Piaget proposed that cognitive development occurs via the interaction of three systems: the sensorimotor, the operational, and the symbolic, and contended that these systems must be understood as distinct (Dowling, 1998).

While the myths of reference, participation, and emancipation mythologise mathematics as being about, for or implicated respectively in non-mathematical activities, the myth of construction also mythologises mathematics. However, as distinct from the first three myths (reference, participation, and emancipation), the myth of the construction “mythologises mathematics as a codification of human cognitive structure” (Dowling, 1998, p. 45). In common with the three above-mentioned myths, the myth of construction conceals the idea that mathematics is primarily a self-referential practice or domain of activity (Dowling, 1998). Whereas the above-mentioned three myths are associated with apprenticeship (i.e. a case where there is a relation between an adept and a novice in the pedagogic context, and where the expert is transmitting that in which he or she is an adept), under the myth of construction “the teacher is constructed, not as an expert in mathematics, but as an expert in teaching, most particularly in respect of the practice of assessment” (Dowling, 1998, p. 46).

Dowling (1998) explained, “the teacher’s expertise resides, in this respect, in classifying students’ actions in terms of a mathematical code, and in prescribing the appropriate tasks for the students” (p. 46).

(v) The myth of certainty

The myth of certainty corresponds to the myth of reference. According to Dowling (1998), this myth is reproduced in the philosophical position described as ‘absolutism’. Absolutists view mathematical knowledge as consisting in certain and unchallengeable truths (Ernest, 1991). According to this view, “mathematical knowledge is made up of absolute truths, and represents the unique realm of certain knowledge” (Ernest, 1991, p. 7). Hence, constructors of this myth believe that verifiable certainty can only be found in mathematics (Dowling, 1998, p. 294). Dowling highlighted this belief with the example that follows. He suggested that if one tells a primary child that World War II lasted for 10 years, he or she will believe it. However, if one tells that child that two fours are 10, the child will argue about it. That means the child might even deny this. Dowling acknowledged that children know what is wrong at their own level of competence in mathematics and can verify things themselves, even if they may not always be encouraged to do so. Under the myth of certainty, individuals are encouraged to believe that mathematical relationships are “valid for all planets, biologies, cultures, philosophies” (Dowling, 1998, p. 295). It has been maintained that individuals cannot imagine a civilisation in which one and one does not equal two. Similarly, they cannot image that there is an integer interposed between eight and nine (Dowling, 1998). Dowling (1998) contended that as with the myth of reference, the socio-cultural is again presented as being divided between mathematical and non-mathematical practices. However, this time, mathematics is constituted as not having referents to the non-mathematical (does not cast a gaze beyond itself). Instead, the mathematical authorial voice is affiliated to a Platonist realism (Dowling, 1998, p. 295). Dowling postulated that mathematical practice is then represented by elementary arithmetic, which constitutes the essential truth and makes it look like no other area of the social or natural sciences where humanity has ever achieved certain knowledge. Again, similar to the myth of reference, Dowling asserted that the myth of certainty exposes some of the self-referential nature of mathematical practices, and it conceals the constructive subjectivity of mathematics (Dowling, 1998, p. 295).

(vi) The myth of cyberspace

The last of the six myths is the myth of cyberspace. This myth “constitutes technology as a revolutionary tool which enables the transcendence of the embodiment of mind”. As Dowling

(1998) puts it, cyberspace itself is presented as a “virgin territory awaiting colonisation by subjects who will transform and release themselves” (p. 301). This myth presents information technology as a set of tools that individuals can grasp to facilitate and expand their activities. Constituting information technology as an intellectual activity, Dowling (1998, p. 301) contended, “intellectual practices still dominate, or at least are still tolerated in certain domains”. The description is here merely included for the sake of comprehensiveness, as the use of technology is not relevant in the context of this study.

Dowling’s ideas of mythology in mathematics education have been discussed in this section. Some of the reasons these myths may be of interest in the context of the Namibian hybrid curriculum will now be highlighted.

Among the aims of teaching mathematics in Namibia, for example, the mathematics syllabus states that the aim of teaching mathematics is to develop students’ mathematics thinking and that mathematics provides pleasure and satisfaction, particularly when learners solve problems and enjoy number games. The first aim focuses on the development of thinking skills or generic thinking skills. This mythologises mathematics as being about the thinking of the pupils. This appears to be a version of the myth of construction. However, if mathematics is construed for developing useful skills, then this would fall under the myth of participation. For the analysis of the Namibian curriculum, this suggests that myths can also manifest themselves in and be circulated via policy documents. Further, the teachers’ and subject advisors’ interpretations might indicate certain preferred myths which determine the way they think mathematics should be or is taught. For instance, if a teacher develops a notion of mathematics as being about describing how the world works or how a certain activity functions, then this would entail a *myth of reference,* and it would be possible to look at whether the teaching, in fact, reflects this in their choice of tasks.

3.6 Conclusion

This chapter has outlined the lens through which the empirical data has been viewed. The chapter briefly gives a snapshot of how Dowling’s (1998, 2007, 2009) domain grid could be a useful tool particularly when attempting to make sense of mathematics lesson.The next chapter sets out research questions and the methods used to answer these questions.

4 Research questions and methodology

In this study, the elements of the framework that were outlined in Chapter 3 will be used in the Namibian context, which has its own specificity. The discourses circulating in mathematics education about relevance, emancipation, critical thinking skills, attitude development, and drawing on students' everyday experience have arrived in Namibia through agencies and their teaching philosophies. These include the United States Agency for International Development (USAID) and learner-centred education (LCE). As mythologising is inevitable in school mathematics, it was pertinent to find out whether some myths were more prevalent than others. Above, the theoretical concepts through which the data will be analysed have been introduced and the theoretical perspective in which the language of description is located have been outlined.

The foregoing chapter dealt with the analytical framing of the study. This chapter will present the overall approach employed in the research design and the strategies used in data generation and analysis. The chapter begins by restating the research goals in Section 4.1. This is followed by the discussion on research questions in Section 4.2, practical constraints in Section 4.3, and data generation in Section 4.4. Section 4.5 discusses how the data was analysed, and finally, Section 4.6 highlights ethical precautions taken during the study.

4.1 Restating the research goals

In this study, a qualitative approach has been taken to investigate teacher practices of bridging the academic and the everyday in the mathematics classroom. A case study methodology is employed. Hitchcock and Hughes (1995, p. 319) noted that a case study is characterised by boundaries which can be defined in terms of temporal characteristics, geographical and institutional parameters, the role of an individual, or characteristics of a group. In this light, some form of boundary to assist the researcher's focus is also defined. Mathematics teachers engaged in mathematics; supposedly incorporating the everyday constituted the researcher's case study, and the specific context of Namibia is also part of the boundary. Within the complexity of the classroom situation, the researcher's main interest was on teachers' ways of recruiting the everyday into their mathematics lessons, and their interaction and exchange of ideas with learners in lessons, drawing upon the everyday in this process. This constitutes the heart of the researcher's study.

Another inspiration for this study stemmed from a declamatory statement in the Namibian school curriculum that urges mathematics teachers to build bridges between the academic and the everyday in their classrooms (see Chapter 1, Section 1.3.1.2). The researcher felt that it would not make much sense to investigate what teachers do in their classrooms (as they incorporate the everyday) without ascertaining how they interpret this declamatory statement. It was also decided to ascertain how mathematics teachers understand that particular statement. This would provide a background on what that particular statement entailed.

It was argued earlier that when curricula initiatives are introduced in a top-down manner, there is no guarantee that recipients will understand or interpret reform ideas in the same way as those who have set them (Xu Guo-Rong, 2011). With this in mind, an attempt has been made to ascertain ways in which mathematics teachers interpret the curriculum declamatory statement. Since 'teachers' beliefs about mathematics, teaching and learning are often identified as obstacles to the successful implementation of curriculum reforms' (Morgan & Xu, 2011, p. 1), determining how they understood the statement was crucial.

In summary, the goal of this study was twofold: first, it was to identify emergent themes that might come out from mathematics teacher's interpretations of the curriculum declamatory statement; and secondly, it was to describe mathematics teachers' ways of bridging school mathematics and 'the everyday' in a mathematics classroom. The concepts of Dowling (1998) described in the previous chapter will be used to address the second goal. Under this lens, the researcher will in this study seek to determine the types of everyday practices and discourses teachers recruit in the mathematics classroom, and uncover trajectories that school mathematics teachers undertake when teaching mathematics. Incorporating the everyday in a mathematics classroom means tapping into student life experiences, as well as drawing from out-of-school activities to facilitate students' meaning-making in mathematics. Hence, one may expect to find expressive domain, but also descriptive domain as a form of mathematisation.

4.1.1 Chosen paradigm

The researcher's approach in this study was through the interpretative paradigm. The researcher's study fits this paradigm for a number of reasons. First, it is commonly understood that studies carried out within this paradigm usually have the aim of understanding the topic of investigation from “the subjective world of human experience” (Cohen, Manion, & Morrison, 2000, p. 22) and by the aspiration to “reach an understanding of some phenomenon that is not yet well understood” (Hodgskiss, 2007, p. 38). Secondly, under this paradigm, a researcher attempts “to understand the meaning people have constructed about their world and experience, and how they make sense of their experience” (Merriam, 2002, pp. 4-5).

This paradigm is in contrast to a normative paradigm, which assumes that human behaviours are rule-governed and therefore have to be investigated by methods of natural science (Cohen et al., 2000, p. 22). The interpretive paradigm offers the opportunity to understand and interpret the world in terms of its actors (Cohen et al., 2000) and enables the researcher “to understand and interpret daily occurrences, social structures, and the meaning people give to the phenomena” (Kawana, 2007, p. 24). In this study, the actors are the school mathematics teachers, and the daily occurrences are mathematics teaching in schools.

4.1.2 A case study was the appropriate choice

A case study is defined differently by different people. There are even differing opinions as to whether a case study is a method or a research design (Mertens, 1998, p. 166). However, the commonality in definitions is that all case studies begin with a desire to understand a phenomenon (Yin, 2003). This study is a case of how mathematics teachers at Upper Primary and Junior Secondary schools in Namibia are attempting to bridge school mathematics and the everyday in their mathematics lessons. In other words, it ascertains what happens as teachers incorporate aspects of the everyday into their mathematics lessons.

A case study appeared to be an appropriate choice for the study. The method relies on “multiple sources of evidence and data collection techniques” (Merriam, 1998; Yin, 1994, p. 8). Its characteristic of being ‘particularistic’ not only implies that case studies focus on a particular situation or phenomenon (Merriam, 1988, p. 11) but also on individual actors from whom the researcher is seeking to understand their perception of events. Case studies are also concerned with a rich and vivid description and analysis of events relevant to a specific case (Hitchcock & Hughes, 1995, p. 317). The researcher tried to engage the study’s participants as much as possible in places and under conditions that were familiar to and comfortable for them.

A variety of methods used in mathematics education are based on having participants (usually teachers or students) work on tasks (usually problem-solving tasks) or through speaking or writing to produce data from which the researcher can infer (Businskas, 2008). Among these, the most popular format used is the semi-structured interview, but other methods have also been used. For example, Liljedahl (2004) used anecdotal reflections to study the 'Aha!' experience of undergraduate students. Aspinwall and Aspinwall (2003) used open writing prompts to study mathematical thinking, while Krebs (2005) used toothpick tasks to study how students generalise from patterns of data. In this study, the researcher used the central curriculum policy statement to infer mathematics teacher interpretations, along with the overarching question discussed in the next section.

4.2 The research questions

As mathematics is required to make reference outside itself in order to develop meaning and facilitate students' access to the esoteric domain of mathematics, it is not only worth ascertaining what links teachers make between mathematics and the everyday, but it is also necessary to determine how teachers make those links. These can be learnt from what teachers do and say. For this reason, the following research questions have been derived:

1. How is the idea of bridging mathematics and the everyday conceptualised by school mathematics teachers in Namibia?
2. What do mathematics teachers do to bridge mathematics and everyday knowledge in the mathematics lessons?
3. How could teachers' ways of bridging the academic and the everyday be explained?

4.3 Practical constraints

There were practical constraints with the study which will be highlighted prior to discussing how the data was generated. With regard to choosing schools for observation purposes, it would have been better if schools from both rural and urban areas were selected. However, due to financial constraints, the researcher was not in a position to select schools that would be representative of these different areas.

There were other constraints in relation to teacher administrative issues. Teachers in schools where classroom observations were carried out had overloaded timetables. This made it difficult for some teachers to make time for post-lesson interviews. Several reasons were given for not having time for interviews. These unforeseen circumstances of teacher unavailability impacted on their chance of making time for in-depth interviews, as well as the opportunity to follow up on some of the emergent aspects of the interview.

4.4 Data generation

It is understood that data is not simply there to be discovered, it is generated via a process that involves researcher judgements, the interaction between the researcher, the participants and the milieu (Guba & Lincoln, 1989; Mason, 2002; Mutemba, 2012, p. 27). For this reason, the phrase 'data generation' instead of 'data collection' has been used in this study. Different types of data were generated in relation to the different research questions stated above, and choices in terms of data generation were made according to the subjects of the research (school mathematics teachers and mathematics lessons).

4.4.1 Principles for selecting schools

Before deciding on the research site, the researcher considered factors that might hinder researchers from gathering information (Cohen et al., 2000). These included expense, time, and accessibility. Based on these considerations, the researcher purposely selected schools within the town of Ongwediva for classroom observation. Purposive sampling is based on the assumption that since a researcher 'wants to discover, understand, gain insight', they need to select a sample from which they can learn the most (Merriam, 1988, p. 48). This type of sampling enabled the researcher to build up a sample satisfactory to the study's needs (Cohen et al., 2000). This did not mean however that the researcher interviewed whoever was available. Fraenkel and Wallen (1996, p. 101) stressed that in purposive sampling, "researchers do not simply study whoever is available, but use their judgement to select a sample that they believe, based on prior information, will provide the data they need".

Four state-owned schools were selected. The choice of schools was made on the basis of students served by each school and also to some extent, the school resource infrastructure. For example, the school may be equipped with internet and a computer laboratory, and the majority of children attending some of the schools feed from the working class communities. Based on their geographic location, the researcher classified all four schools as urban with minor differences between them. The majority of learners who attended two of the schools were from the nearby villages. These schools were either primary or combined schools ranging from grade 1-7 or grade 1-10.

Merriam noted that the key effort of qualitative research “is to understand a situation in its uniqueness as part of the context and particular interaction there” (Merriam, 2002, p. 5). He added that such “understanding is an end in itself” because “qualitative studies do not attempt to predict what happens in the future necessarily” but attempt to “understand the nature of that setting” (Merriam, 2002, p. 5). For this reason, these four schools were chosen although not necessarily being representative of all Namibian schools. Moreover, case studies are important not only for predictions but also “for what they reveal about the phenomenon” (Merriam, 1988, p. 11).

4.4.2 Selection of participants

Two categories of participants were selected for this study. These categories included subject advisors for school mathematics serving at both national and regional level, and Upper Primary and Junior Secondary teachers teaching school mathematics at grade 5-10.

Subject advisors: Four subject advisors were interviewed in total. Subject advisors are also known as education officers (EOs). They were selected based on the nature of their work. They were also mathematics teachers by profession. Given the nature of their job, subject advisors are part of the panel that usually designs or develops the mathematics syllabus. They are also responsible for guiding mathematics teachers at the 14 education regions of Namibia in the proper implementation of the mathematics syllabus. As with the schools, the subject advisors were selected purposively. The selection was done in such a way that a proportion of administrators from national and regional levels was included. The administrators’ perspectives were necessary in order to add to the understanding of the official language contained in the mathematics syllabus, particularly on what the declamatory curriculum statement entailed.

School mathematics teachers: Apart from their interpretations of the curriculum statement, school mathematics teachers were necessary to demonstrate how the bridging school of mathematics and the everyday is enacted in the classroom.

Observed teachers: Two teachers were observed from each school. This gave a total of eight teachers. At least two lessons were obtained from each teacher, but some were observed three times depending on their availability. Four mathematics teachers from Upper Primary phase and the other four from the Junior Secondary phase were observed (see the observation plan in Appendix 1). These teachers were all qualified mathematics teachers, and their teaching experience ranged between 5 to 20 years. Four of them were male, and the other four were female, all teaching grade 5-7 or 8-10. Arrangements for the observations were agreed with the school and the teachers themselves. Further details on the classroom observation are provided and discussed next.

Interviewed teachers: During classroom observations, video recordings were used. One camera was used, which was positioned in one of the back corners of the classroom. Although not all of the students were visible in the image, their voices were all captured. In addition, two voice recorders were used to back up the camera, and as a reinforcement tool, in case the voice captured by the camera was not clear enough. Field notes were also made. These were not guided by a pre-organised observation guide but were necessary, as they enabled noting lessons where the everyday was incorporated. A minimum of two lessons were observed for each teacher, and 24 lessons were observed in total.

Transcription of classroom recordings: Some 18 of the 24 observed lessons were transcribed and analysed. No forms of links were observed on those excluded. Though the official language used in Namibian classrooms is English, some teachers made utterances in local languages. In the study, the transcripts are presented in English, and where utterances were made in a local language, effort was made to translate them into English. Most of the time, the teacher started his conversation with a question, students answering, often in chorus and with the teacher eliciting the students' answer, generally in a turn-taking scheme. At times, there were simultaneous responses at the beginning of some of the lessons which delayed classroom proceedings. Although interjections, such as um, aayee or aam, short pauses, self-cuts and restarts are transcribed, the level of analysis does not make use of these features of the talk. Some of these are included for easy readability. For confidentiality reasons, the names of schools are anonymised, and the names of participants are identified by pseudonyms. Although italicised words, phrases and statements are introduced to 'indicate some form of stress' (Brinkmann & Kvale, 2015, p. 209), in this study, italicised words, phrases and statements inside single parenthesis are introduced to indicate a translation from a local language to English. Other transcription conventions employed are adapted from other researchers (Gumperz & Berenz, 1993). Table 3 shows transcription conventions used in transcribing the observed data.

Table 3: Transcription conventions

Transcription sign	Meaning
I	Interviewer
T	Teacher
S	Student
Ss	More than one student; generally fewer students than in the chorus (Ch)
Sos	More than one student. It is used when it is visible that two groups of students have different ideas
Ch	The whole class speaks in chorus
...	Ellipsis shows a slight pause
Untimed pause ((pause))	Untimed gaps between utterances are described with double parenthesis and inserted where they occur
Non-lexical or non-vocal phenomenon, e.g. [laughter]	Brackets [ ] are used to identify non-verbal communications which are hard to transcribe, such as laughter or coughing
Inaudible section **( )**	Single parenthesis indicates inability to hear
Best guess, **e.g. (**I think I should just leave it.**)**	For example, if the researcher makes the best guess of what the respondent said, then the single parentheses will be used to surround the transcribed phrase
(( ))	**Double** parenthesis indicates transcribers' description rather than transcription. For example, they are showing teacher or learner actions
Filled pauses (e.g. Um)	Filled pauses in this text are non-words that a speaker uses to indicate hesitation or to maintain control of a conversation while thinking what to say next
- Self-cut	A **hyphen** indicates an abrupt cut-off, break off or self-interruption of the sound in progress. For example, one writes again 52 point-
-- Restarts	Indicates that a respondent stops short, cutting him/herself off before continuing with or rephrasing the utterance
X, Y, or Z	In case of a name, capital letters are used for anonymity
Acronyms: kg, g, km	Are used when a speaker did not say the word in full as in kg (Kei gi)

Transcription sign	Meaning
Numbers (e.g. 500)	Numbers are spelled as they were said by the speaker. However, if a speaker says 500 as ‘five zero zero’, with pauses between each digit, then this is transcribed as ‘five … zero … zero’
?	A question mark is used to indicate a question (rising intonation)
.	A period is used to mark a falling intonation
word	Italicised words or statements in single parenthesis are used when what is uttered in another language than English is translated into English (i.e. the researcher’s own words)

4.5 Data analysis

The tools introduced in the analytical framing chapter are part of Dowling’s “internal language of description” (Dowling, 1998, 2000, 2007). These tools are constituted by the schema for the domains of practice and the DAS scheme and were used to analyse the classroom data, which was divided into episodes. Segments of data within episodes were labelled according to domains of actions which the text seemed to suggest. This means that dialogic texts produced during teacher-learner interactions were categorised either as public domain, esoteric domain, expressive domain, descriptive domain, or something else. The use of the DAS schemes is discussed further in Section 4.5.2.

The data was also analysed in terms of the notion of myths of Dowling (1998). Sethole (2007), in line with others who adopt a more empirically driven approach than the one outlined above, argued that a theory may not exhaust data, and this forces a researcher to subsidise a theory either with other theories or concepts from other theories within the same perspective. In this study, initially Dowling’s DAS scheme and notions of myths were sufficient for reading the data with respect to the research questions. However, to some extent, the data also revealed some interesting features that one could not anticipate in terms of the chosen theoretical tools. Data generated from classroom observation and interviews included some text which was very diverse and not easy to be categorised, and therefore an overall analysis could not just be achieved by using the a priori theoretical tools. The examples from the classroom observation documented in this study comprise the range of versions of making links that teachers employed while bridging mathematics and the everyday in a mathematics classroom (see Figure 13). In the interviews, there were some non-anticipated ways teachers and also advisors spoke about relating to the declamatory statement, which had not much to do with ways of mythologising mathematics but rather with their reflections about their own awareness.

While the theoretical tools introduced above make it possible to reconstruct a layer of meaning that is outside the reflective awareness of the participants, which is one assumption of the sociological analysis by Bernstein and Dowling, among others, it was also important to look at the meanings the participants themselves attributed to the statement from a more ethnographical point of view. This then is an analysis at another level, which also contributes to the insights on research question 1.

For this reason, a grounded approach was introduced for interview data. Interview data was analysed by identifying emergent themes. The approach proposed by Charmaz (2006) guided the analysis. Highlighting analytic journey in grounded theory practice, Charmaz (2006, pp. 42-66) identified two main phases in grounded theory development. These consist of initial coding and focused coding. Initial coding involves close studying of data, defining what is happening in it, and naming each segment of data in codes. In focused coding, one "selects what seems to be the most significant initial codes, and test them against the most extensive data" (Charmaz, 2006, p. 42). Charmaz (2006) defined coding as a process of "naming segments of data with labels that simultaneously categorise, summarise and account for each piece of data" (p. 43).

According to Charmaz (2006), this analytic process involves a number of stages, and the first two can be done concurrently. They are *initial* coding, *focused* coding, *axial* coding, and *theoretical* coding. Axial coding entails sorting, synthesising, organising large amounts of data, and reassembling it in new ways after *open* coding. This stage involves development of major categories, *relating them* to subcategories, and bringing data together into a coherent whole. Charmaz maintained that a theoretical coding is a sophisticated level of coding in which a researcher has to conceptualise "how substantive codes may relate to each other as hypotheses to be integrated into a theory" (Charmaz, 2006, p. 63). Differentiating the last stage from the first three, Charmaz (2006) contended that while "grounded theory coding generates the bones of analysis, theoretical integration assembles the bones into a working skeleton" (p. 45).

Going through transcripts, codes were identified and named based on what and how respondents were talking. As a result, themes emerged, and some categories ensued. Though the main issue in interviews was about how teachers interpreted the declamatory statement, respondents ended up talking about other aspects that are important for understanding their practice of bridging the academic and the everyday in the mathematics classroom. The next subsection provides details on how interviews and observed data was analysed. First, though, the strategy and some examples of how the interview data was interpreted are presented.

4.5.1 Analysing and coding of interviews

4.5.1.1 Selection procedures and recognition rules during the coding of interview transcripts

This part is necessary in order to clarify how the analysis of teacher interviews was done. It is intended to highlight coding procedures that were followed, give access to the content of what was done, as well as to highlight how this analysis arrived at certain conclusions. Some details on selections and recognitions that were made are presented below.

Selection and recognition rules

The following process helped in deciding on what was significant and prevalent. During the initial stages of the analysis, each teacher's transcript was coded by naming lines, segments of data (see sample transcript in Appendix 6). Mythologising of non-mathematics by mathematics teachers emerged as teachers interpreted the declamatory curriculum statement, and these were among the named codes. For instance, all the teachers who appeared to interpret the declamatory statement or talk in a way that suggests a construction of mythology (as proposed by Dowling (1998)) were put into different categories of myths. A theme that incorporated the three categories was labelled *interpretations in terms of mythology.*

Recognising the myth of participation

Analysing each transcript, the following indicators were cues that suggest a myth of participation. Anytime that there was mention of anything that is everyday non-professional activity, where mathematics is portrayed as a necessary condition for carrying out a certain activity successfully, then that particular teacher was deemed as constructing the myth of participation. If in talking about the statement or any of its concepts, the teacher portrayed mathematics in terms of use values (i.e. a necessary tool) or in a way that suggested that somebody needed mathematics to be able to participate in a certain activity or practice, then that particular teacher was deemed as constructing the myth of participation. Furthermore, articulations that suggested that one needs mathematics for survival constituted the construction of the myth of participation. Teacher Pandu below suggests that mathematics is a necessary tool and that if the person does not know mathematics, that person is left behind with many things. Other indicators were suggestions that creativity and being able to do things result from being able to measure correctly for example. Any response in these directions was constituted to be a myth of participation. The following quotes by different teachers signal the myth of participation:

> ***PANDU:*** *Well, I think it means that mathematics is a language that um- is a language that applies to all the things that are happening in life. That means if the person does not know mathematics that means that um that person will be left behind with many things.*
>
> ***KAFULA:*** *The way I understand it is this. You know, mathematic is being used in everyday life, but in most cases, people use mathematic unknowingly. But- in everyday life, people are using mathematics, and there's a need for this one. For somebody to know mathematics or to know something, only if there is a need. Therefore it's always good to create a need. A need for the topic so that learners will know that if I'm studying this one, why should I study this one? Because if there is no need, then it's useless. It is also needed to link to the real situation, to the everyday life situation. That's how I understand it.*
>
> ***SAKEU:*** *That means that mathematics is used worldwide, everywhere, even illiterate people can use mathematics. Mhh, in farming one can count his sheep or goats. Banks, even an entrepreneur counts his or her money. Actually, mathematics is a universal language.*

Teachers who interpreted the curriculum declamatory statement in this way are perceived as constructing a myth of participation, as well as drawing on the *public domain.*

Recognition rules for myth of emancipation

The myth of emancipation was recognised in the following ways: The teacher was deemed as constructing a myth of emancipation if in talking about the statement, or its concepts, they made reference to mathematics in ways that appear to suggest an ethnomathematics view of mathematics. Any response by participants that seemed to celebrate the pre-existence of mathematical content in certain cultural activities or artefacts is taken as a myth of emancipation. For example, any response that seemed to suggest that mathematics already existed in communities because people were already able to count even before the introduction of formal education is construed as the construction of the myth of emancipation. The following examples are quotes from teachers signalling the myth of emancipation:

> ***HANDJE:*** *Because in the community, before we have got the books that we are using today, people already know how to do the calculation. And those calculations that are already known by the community members may be used and link to what people have done through the observation so that they come up with the syllabus which is used today with the students here. People are using the previous knowledge as well as the knowledge that is obtained through observation.*
>
> ***KAFULA:*** *Yes, yes really because that one helps them to understand what they are doing. It's just like a game the way this traditional game, Owela, and again you think about some of our elders that don't know how to read properly and talk properly, but you will find them playing that one. They can even count for three rounds ahead.*
>
> ***VATUVA:*** *When we talk of math, we are talking of numbers, we are talking of calculations, and it's something which is practised on a daily basis. People need to calculate their positions. Even at home, before the introduction of formal education, people had mathematics. They have to know how many pigs do I have, how many container, jars.*

Recognition rules for myth of reference

The *myth of reference* is about understanding how the world works from a mathematics point of view. Therefore, the researcher recognised the myth of reference by understanding something using mathematics techniques. Anytime there was mention by a teacher that mathematics is about something other than itself, then that particular teacher was deemed as constructing a myth of reference. If mathematics was used as a tool for describing and understanding world events, then that articulation was construed as constructing a myth of reference. Any response that suggested that mathematics explained the world and how things were was also taken as the construction of a myth of reference. If a participant talked about mathematics in a way that presented it as if it was an essence of things, then this was also taken as a myth of reference because such a person is recontextualising the world from a mathematical point of view. Articulations that suggested modelling activities were also included and constituted as the construction of a myth of reference. The myth of reference stems from the esoteric domain. The public, expressive, and descriptive domains are all the result of a gaze cast from the esoteric domain. One can say mathematics is present if one activity is talking about another. While in the myth of participation mathematics is like a technique that one needs, in the myth of reference mathematics is taken as something that explains how the world is, how the world works, and even how something operates. If anyone interpreted the declamatory curriculum statement or articulated it in any of these ways, then he or she was perceived as constructing a myth of reference. The following quotes are among those that signalled the myth of reference:

> ***Subject advisor (Mrs Walter):*** *Application is the way; I said it already. What we learn here, how do we apply it? For example, um, you have a business, whereby you have applied mathematical concepts or strategy to solve an issue. Let's look at linear programming for example. You have a business where you involve trucks or transport where you have buses. Which one is the best option to use in order to get a maximum profit and so on? That is what I understand by application. How do we apply mathematics concepts to solve everyday problems?*
>
> ***CARLOS:*** *Local contextualisation is how a person can use the knowledge you have to calculate using the formulas, and also knowing how to use operations in maths in everything you do.*

Other strategies helped in seeing emerging patterns and what was prevalent. For example, when all three categories of myth were put in a table, the researcher was able to see which type of myth was talked about more, or the least. When teachers' responses (say, those whose responses pointed to the myth of participation) were brought together in table format, the researcher was able to see differences in teacher articulations.

Coding the rest of the interview transcripts followed a similar fashion. The form of analysis used to arrive at emergent ideas, such as those presented in *Section 5.3* to *5.4* of Chapter 5, is what is termed as open coding. In determining teacher awareness of the existence of the declamatory curriculum statement and the extent to which they consider the declamatory statement in informing their practices, the researcher read through the data and created provisional labels for sections of data that appear to summarise what she saw happening. Examples of participants' words were recorded, and the properties of each code were established. This form of analysis was not, however, based on existing theory; it was just based on the meaning that the researcher saw emerging from the data. To some extent, NVivo was used in organising data; however, the researcher had to abandon it when it became less useful.

4.5.2 Analysis of observed lessons

First, it was necessary to determine different forms by which the teachers realised didactical purposes. Because of this, the observed lessons were analysed to determine the interactional patterns during teacher practices of bridging the academic and the everyday. Lessons were divided into sections of episodes. To do this, the format of describing the lesson structure of the observed lessons of Jablonka (2004) was used. It should be mentioned here that there were minor modifications employed either on the naming of didactical functions or on the naming of interactions. This is done because the nature of the classrooms from which Jablonka's analysis was made was slightly different from the observed classroom in this study. Lessons were categorised in sections such as the Setting stage, Review or Revision, Sharing, Introducing and/or developing new knowledge, as well as Practising and Applying. These sections will be fully defined in Chapter 6. Next, the structure of the lessons was described according to various forms of interaction. These forms of interaction are also defined, explained and presented at the beginning of the chapter on teacher practices. These analyses produced several tables from which conclusions were inferred (see Tables 7 and 8).

The next analysis used the tools of pedagogic strategies of Dowling (1998, 2000, 2007): the four domains of actions. The lessons were divided into episodes of texts which were then used to indicate what pedagogic strategy was recruited by the teacher at a certain point of the lesson. By pedagogic strategy, reference is being made to whether the piece of text was categorised as esoteric, public, expressive, and a combination of any of these. Several excerpts were included and used for different purposes: (1) excerpts were either used to show how teachers used different teaching approaches to making links, (2) to show what pedagogic strategy the teacher was employing, and (3) to highlight students' possibilities of relating with and benefiting from the expressive domain strategies. Episodes of texts were also used to derive several modes of localisation, as well as several versions of making links. The phrase 'modes of localisation' was used to refer to the extent to which the task set or recruited by teachers leans towards the myth of participation or the myth of reference. These are explained further in Chapter 6.

4.6 Ethical considerations

Ethics has to do with doing what is right (Cohen et al., 2000). It is stressed that the sole responsibility of the researcher is to make sure that research participants are fully protected by not revealing information that leads to exposure of their identity. Fraenkel and Wallen (1996) noted that the most important ethical consideration of all is that the researcher should protect participants from any sort of harm. To ensure that ethical practices are followed in this research, a numbers of things were done, which will be presented next.

Initial ethical approval was sought via relevant King's College London Research Ethics Panel (REP) and Research Ethics Subcommittee (RESC). The subcommittee through which the approval was sought was the Education and Management Research Ethics Panel (E&M REP) under the School of Social Science and Public Policy (SSPP). Guidelines on good practice in academic research were followed, and recruitment letters, information sheets, and consent forms were prepared. Following this, approval was granted by the King's College London's E&M REP.

A second approval was also sought from the relevant Namibian authorities through the Ministry of Education and the Directorates of Oshana Education region (see Appendix 10). The researcher wrote to the Permanent Secretary, in the Ministry of Education. The Permanent Secretary contacted Directors of Education in Oshana and Ohangwena region as custodians of schools in these educational regions. In the application letter, the researcher's identity and the rationale for doing the study were indicated. Careful attention was paid to issues of confidentiality, anonymity, non-maleficence, and the welfare of all participants. After the approval by Education Directorates, the Directorates informed the principals of identified schools, informing them about the study that was about to take place. There was a strict warning not to cause any distraction to the normal daily activity of the school in regard to teaching and learning.

For anonymity purposes, during the presentation of findings, subject advisors' names will be identified by pseudonyms such as Ms Botham, Ms Jonas, Ms Irene, and Mrs Walter respectively. Subject advisors are alternatively known as education officers. School teachers will also be identified by pseudonyms.

4.7 Limitations of the study

Because of financial constraints, the study only observed teachers from semi-urban schools. It would have been ideal if schools from both rural and urban areas had been chosen. If there were more disparity between the empirical sites (observed schools) in terms of geographic locations and the nature of students being served by the schools, the data might have been richer, and some interesting contrasts might have emerged. There were also some limitations in terms of interviews, as not all teachers allowed time for post-lesson interviews.

Since this study observed only a couple of classrooms in the northern part of Namibia and interviewed a limited number of school mathematics teachers, the study's findings may not translate to other school mathematics teachers from other socially and culturally different educational regions of Namibia. A sample that had represented teachers from each of the 14 educational regions of Namibia would have been ideal.

Another limitation concerns the handling of translations. Since some of the teachers code-switched between the English language and one of the local languages, transcription and translations were complex and challenging. For these reasons, some of the utterances are presented in the language in which they were uttered.

Although more lessons were observed and underwent an initial analysis, only seven lessons were used as examples to be presented in detail and to draw conclusions on classroom observations. These lessons were chosen based on the fact that different topics were taught by teachers.

Unlike recording time taken per didactical function, it is cumbersome to record the time taken per domain of text as indicated in Table 9. This is because of the fractal nature of the codes, as some episodes have smaller themes under higher-order themes, and some of those themes took less than a minute. It was difficult to visually represent a time span less than a minute in the format chosen.

To some extent, myths also posed a challenge during the analysis because myths are inherently implicit notion. When one tries to identify them, at times, they are not that easy to pin down. This does not mean, however, that the respondents were not explicit in their mythologising, but this means that there are times when an utterance could point to more than one myth.

4.8 Conclusion

In this chapter, details were given on how the data is to be collected and analysed. Aspect of methodology that might impact or influence the interpretation of the findings are highlighted. These are for instance the constraints on generalizability, applicability to practice, and/or utility of findings that are the result of the ways in which the researcher chose to design the study. The next two chapters will present the findings of the study.

PART IV

5 School mathematics teachers' and subject advisors' sense of bridging mathematics and the everyday

The previous chapter dealt with the research questions and methodology of this study. This chapter presents findings obtained from the interviews conducted with school mathematics teachers as well as subject advisors for mathematics. The chapter begins by presenting ways in which both mathematics teachers and subject advisors made sense of the declamatory curriculum statement which was used as a probe during the interviews, as it was speculated that some of the respondents might not say a thing. These are the ideas presented in Sections 5.1 and 5.2. Sections 5.3 and 5.4 present other significant ideas that emerged from both subject advisors' and school mathematics teachers' interviews. Section 5.5 summarises the chapter findings.

5.1 Ways in which subject advisors made sense of the declamatory curriculum statement

Although the subject of bridging academic mathematics and the everyday is talked about in different ways, the findings suggest that subject advisors interpreted the statement in two ways. First, subject advisors interpreted the statement in ways that could be interpreted in the light of Paul Dowling's myths of reference, participation and emancipation (Dowling, 1998), discussed in Chapter 3. Secondly, subject advisors interpreted the statement in a way that suggests a focus on a pedagogic approach to bridging mathematics and the everyday. While doing this, they emphasised the significance of taking into consideration the introductory pages of the mathematics curriculum from which the declamatory statement was taken. They also mentioned various benefits that accompany the supposed teaching approach. Articulations that signify the importance of the syllabus' introductory pages and benefits associated with the subjects of incorporating the everyday in the mathematics classroom are attached in Appendix 7.

Findings also suggest that the subject advisors are aware of the statement. They talked about the curriculum statement in relatively informed ways, and the concepts appear not to be foreign to them. However, there was a subject advisor who indicated a sense of uncertainty on what the term ‘local contextualisation’ could mean, and the same advisor could not determine how the statement could influence mathematics teachers’ work. Figure 3 summarises different ways in which subject advisors made sense of the statement in terms of mythology. The summary that explains the figure is presented after Figure 3.

- Mythologies
  - Myth of reference
    - Use mathematics to achieve certain goals such as to model activities and to solve real-life problems. *For example, understanding how much profit one can make after using a certain type of transport.*
    - Use mathematics for curiosity or to barely get insight. *For example, make use of acquired numerical knowledge and skills to determine the number of kilometres between two places, even by mere reading of road traffic signs.*
    - If mathematics is construed as being "everywhere", the term *everywhere* could mean that mathematics is in the nature, or perhaps in cultures. A person is able to recognise the mathematics in an activity if he or she is able to make a mathematical model of these.
  - Myth of participation
    - Mathematics is construed as a *precondition* that enables carrying out certain actions. For example, *"Because I have to know mathematics to do this"*.
    - Portraying "mathematics terms" as necessary *tools* for use in non-mathematics activities such as domestic ones. The mathematics term of "*counting"* was used as an example in optimising cooking and tea-making activities. *"Counting the number of cups of water you have to put in the pot for example. That's already a term used in mathematics".*
    - Mathematics is construed as a *passport or ticket* that qualifies somebody to a certain job or career, e.g. *"If you want to be a painter in construction. If you want to be in what and what, these are the basic things you should do".*
    - Mathematics is construed as a means to expose mistakes and corruption and creating social awareness. *For example, "So that when you are building the builders will not rip you off".*
  - Myth of emancipation
    - Mathematics is construed in the light of one of the ethnomathematics view of mathematics. *For example, "It (mathematics) is not something from somewhere, being imposed on them (students). The moment the learners are made to realise that there is so much of what they have already with them in their communities, that is, in mathematics, or actually mathematics is actually about that, then it will help the learners to really love and enjoy the subject".*

Figure 3: Different ways in which subject advisors made sense of the declamatory statement in terms of myths

5.1.1 Interpretations that suggest the construction of myth of reference

At times in their use of examples, subject advisors interpreted the statement in a way that suggests that in everything people do in their everyday life, they do not only use mathematics to achieve certain goals but also use it to get insights for solving real-life problems. For example, in an attempt to explain what the term application in the declamatory statement could mean, Mrs Walter narrates:

> *What we are learning here is how do we apply it? For example, um, you have a business, whereby you have applied the mathematical concepts or strategy to solve an issue. Let's look at linear programming for example. You have a business where you involve trucks or transport where you have buses. Which one is the best option to use in order to get a maximum profit and so on? That is what I understand by application. How do we apply mathematics concepts to solve everyday problems?*

With this example, the subject advisor indicated how one can use mathematics to model economic practices. Mrs Walter especially singled out linear programming (one of the themes in mathematics syllabus) and proposed that if somebody wants to determine how much profit he or she could make, she or he could get this understanding using knowledge and skills gained from this mathematics topic. This articulation illustrates that one might necessarily employ some mathematics knowledge and skills if one is to model the real-life problem. Mrs Walter shows how mathematics can be exchanged for an economic activity of determining minimum and maximum profit after utilising various types of transports in the business. Different from the above example, Ms Jones below suggests individuals unconsciously make use of mathematics to get insight. However, her example does not seem to point to modelling other activities with mathematics; rather, her example seems to point to using mathematics skills of literacy and numeracy (mere counting and reading) to gain awareness about a person's environment.

> *Like I said um, we almost use mathematics everywhere. Um, say when you came here I know you didn't know how many kilometres are here from Ongwediva or Nghifikepunye Pohamba to this place. But then when you reach here then you find aha, this is Gobabis [anonymised]. In one way or another, you are already counting for example the kilometres although you did not think you are using mathematics in everyday life. Though you are not in the classroom teaching mathematics but then you have already made use of mathematics there.*

Again, the advisor's introduction of the utilisation of mathematics in everyday life such as in estimating kilometres between two places and perhaps reading kilometres from traffic signs (noticeboards along the road) seems to point to the myth of participation. The three myths seem to be circulated interchangeably by teachers.

Similar to Mrs Walter and Ms Jones, Ms Irene below suggests that even if an individual wants to determine how much money or animals there are, or how many cups of water to put in a pot while cooking, these actions are referred to as mathematical practices.

> *As for me, it (the statement) just explains the very things that I have talked about. Mathematics is already with us. It is already being there. We grew up with that. We are seeing it in everyday life. In whatever we are doing. Counting coins, counting our cattle, counting our goats, whatever it is we are doing. Even if we are putting cups of water in the pot, we know what to put, how much we have to put, how less we have to put, and it is something that is with us.*

This teacher is not directly stating that mathematics is a requisite or prerequisite for engaging in in these activities; instead, Ms Irene is saying that these activities are mathematical. Although one cannot deny the utilitarian aspect of mathematics, some non-professional activities may not require mathematics knowledge and skills as a precondition to carry them out, let alone to optimise them. However, there are those activities that, depending on the circumstance, might require basic skills of counting and measurement.

On the other hand, mathematical activity here is interpreted as an unconscious act, much in the way some writers in 'ethnomathematics' do. With saying "we grew up with that" and that mathematics is already in "whatever we are doing", this points to a myth of emancipation. Using numeracy skills is then not a matter of choice anymore. This also suggests that myth might be used interchangeably.

5.1.2 Interpretations that suggest construction of the myth of participation

Subject advisors did not only interpret the statement in a way that suggests the construction of the myth of reference. They also interpreted the statement in a way that suggests that individuals need mathematics to enable them to achieve certain goals. In some articulations, subject advisors made statements that are lending themselves towards the idea that one needs mathematics to enable one to participate in certain activities. The participation issues referred to by administrators on various occasions include dealing with money, such as in buying or selling, cooking, making tea, filling one's car, and other mundane situations. In her acknowledgement of the importance of the subject of bridging mathematics and the everyday, Ms Jones below suggests that one needs mathematics to be able to do certain activities.

> *I think the whole topic seems to be important, important in the sense that we should know what we are doing in the classroom. Even our learners when they are getting out there they should be able to integrate although that very moment they are being taught they might not be able to link, or to find why it is necessary to study mathematics. Because I have to know mathematics to do A, B and C.*

But then they should be able to link and know why it is important to learn mathematics. That is one of the importance because one knows mathematics is also one of the aspects that you should make use of during everyday activity that you might do.

Here, Ms Jones constructs the myth of participation in different ways. First, she appears to portray that knowing reasons for studying mathematics is necessary for knowledge integration or to be able to do A, B and C. Second, mentioning that mathematics is one aspect that a person should be able to make use of during everyday activity does portray mathematics as a necessary tool.

Likewise, utterances that suggest the myth of participation seemed to be evident in Ms Irene's articulations:

We almost use mathematics in everyday life. Say you are cooking; you have to count the number of cups of water you have to put in the pot for example. That's already a term used in mathematics. You have to send maybe a kid to go and buy bread. You give him or her some coins, you already know you applying mathematics. Though sometimes in the way we are applying it, we might not think that we are applying mathematics stuff. But then at the end, we are using it though we cannot really say I am teaching my kids mathematics here. You should put how many cups of water … how many spoons of tea when you are making – I mean how many spoons of sugar when you are making tea and so on. Then that's already some basic mathematics.

First, in this articulation, Ms Irene fetched on non-mathematics activities of cooking and tea making and clearly mythologised them as mathematics activities. Secondly, the mathematics term "counting" is used as an example that optimises other (non-mathematics) activities such as cooking and tea making. Further articulations that suggest a construction of a myth of participation are explicit in Ms Irene's remarks.

Different from Ms Jones and Ms Irene, Mrs Walter below suggests how the ability to possess certain mathematics skills could afford them not only employment opportunity but also necessary social self-defence skills against common fraud:

For some of the learner may never have heard of those words but when you come in you should know for example Mensuration. If you want to be a painter in construction. If you want to be in what and what, these are the basic things you should do. People are being paid per square metre, or whatever the thing is fit for the square kilometre. Here are square kilometres, how many boxes of this one. If you are into construction, you should understand this. If not into construction, know so that when you are building the builders will not rip you off. You should be aware of these issues.

This excerpt highlighted necessary mathematics that individuals might need to participate successfully in other practices such as in construction work, painting, and tiling.

5.1.3 Interpretations that suggest construction of the myth of emancipation

During articulations on how she makes sense of the statement, as well as during the time Ms Irene highlighted what she perceived as the most important aspect in the interview discussion, Ms Irene said that mathematics is not something imposed on learners, but it is something that they already have in their communities. This appears to resemble some of the ethnomathematics views of mathematics.

> *What I see is the main thing that we talked about is just about linking. Which for me is very important. I mention it earlier. Most of our learners, for example, they get to think that the moment they hear mathematics, the terminology is long and big and sounds strange. But the moment the learners are made to realise that there is so much of what they have already with them in their communities, that is, in mathematics, or actually mathematics is actually about that, then it will help. So this thing of linking mathematics to the everyday life helps the learners to really love and enjoy the subject. It makes the learners really want to study the subject because they see that it is connected to them. It is not something from somewhere, being imposed on them.*

In this articulation, by mentioning that mathematics is actually about that which is in communities, which might help to overcome cultural alienation from 'strange' terminology that is 'imposed on them', Ms Irene constructed the myth of emancipation. However, projecting mathematics is actually about that in their communities, signaling the construction of the myth of reference.

In another example, Ms Irene proposed an ideal implementation strategy for the declamatory statement. She suggests:

> *We can even look at the way they (students) play soccer for example. There are lot of extracurricular activities they can do but they are involving mathematics. One of the questions one would ask will always be: Ok, in the last 24 hour, jot down whatever you have done and you have used mathematics. You will end up having people jotting down, and that is always one of the warm-up question we have. People may now start realising that mathematics is everywhere. From how much you put on the toothbrush, how much water you are going to think is enough, and how much water you are going to put in the pot, how do you balance hot water and cold water so that you can take a bath and all these things. It is everything we do involving mathematics and as a teacher not only in the classroom. We need to sensitise the learner for them to be aware that whatever they do involve mathematics. You have to measure that my feet fit at that space. Mathematics we use it unconsciously without knowing that it is mathematics.*

Ms Irene began by suggesting what mathematics teachers could recruit as resources for mathematics teaching in their classrooms. Her suggestion was that teachers could start by brainstorming. This brainstorming could involve asking students to jot down whatever they have done or previously engaged in and naming activities in which they have used mathematics. In her utterance, the subject advisor is again constructing the practice of teeth brushing and that of balancing bathing water as activities of mathematics. While this advisor's use of the phrase 'mathematics is everywhere' at some point seemed to suggest the myth of reference, the above statement suggests that mathematics is everywhere in cultures. At the same time, this implies that these forms of mathematical activities are necessary in order to participate (myth of participation), but actually, the students do not have to learn them. This is a myth of emancipation. Although Ms Irene suggests that learners have to be sensitised to create awareness that whatever they do involves mathematics, Ms Irene did not explicitly say anything that suggests the uncovering of the already existent mathematical content in these activities. It appeared as if the subject advisor constitutes mathematics as always already in the lives of everyone, and that individuals are constantly seeing and doing mathematics. This is the fundamental characteristic of the myth of emancipation. The myth of emancipation seems to be the right category here, even though in this case, perhaps it is without the political motive of Gerdes (1988a) or D'ambrosio (1985, 1990).

Furthermore, her utterance of mathematics is everywhere 'from how much you put on the toothbrush' to balancing water temperature appears to highlight the necessity of mathematics as a tool in other activities. Ms Irene does not only suggest that mathematics is a component of almost everything that people do (like an unavoidable ingredient in a recipe) in their daily activities but she also seems to suggest that mathematics techniques are needed to optimise these activities and to successfully engage in them. Do participants in these activities need maths techniques to enable them to carry them out successfully? Perhaps the need for it might depend on the context and circumstance. Similar to the argument above, a number of people might use toothpaste and balance bathing water spontaneously. What the researcher seems to get from this discussion is that all subject advisors buy into the forms of mythologising. From their statements, they seem convinced and happy to state their viewpoints explicitly. What seems to be a challenge is that the myths are an inherently implicit notion, and that when one tries to put their finger on them, they are hard to pin down.

Ways in which subject advisors interpret the statement in terms of the mythology originally proposed by Dowling (1998) have been discussed. The subsection that will follow will discuss other ways in which subject advisors talked about the declamatory statement.

5.1.4 Interpretations that focus on pedagogic strategies for teaching mathematics

In one of the sessions, Ms Botham narrated that the presence of the declamatory statement in the syllabus serves as a direction for teachers to link the mathematics content they are teaching to learners' real-life situations. According to her, this is necessary for the learners to be able to understand reasons why they are doing mathematics in the classroom:

> *My pure understanding of um-- pure understanding of that sentence is for the teachers to be able to link to what they are teaching to learners' real-life situation for the learners to be able to understand why- the reason why they are doing mathematics in classroom. Because if you don't contextualise, if you don't put the flavour of the local environment or the uses of the mathematic then you might find yourself teaching learners who do not know the need of doing mathematics in life.*

Adding a 'local flavour' is here mainly a pedagogic strategy. In another session, Mrs Walter shared a similar interpretation. Mrs Walter found that the teaching of mathematics in the classroom should reflect the 'real life' or the 'daily life' of the child in order to provide motivation and recognition of the importance of learning mathematics.

> *For myself, I believe mathematics should not be taught in isolation. What I mean is, you can apply all the rules and the learners can compute whatever thing you have given them. But, if you did not involve the application of that computation within their real life, they might not see the importance of what it is they are learning there in the classroom. I normally make sure that the mathematics you are teaching in the classroom reflects the real life or the daily life of the child.*

Mrs Walter seems to see the division between mathematics as an activity and other non-mathematics activities. This was revealed by her view that the statement implies that the subject of mathematics should not be taught in isolation, but that fetching on the everyday via mathematics applications is a necessity. The view of applying mathematics in Mrs Walter's articulation points to the idea that teachers need to show their students not only how mathematics relate to other everyday activities but also to show them how mathematics could be used in other activities. Indeed, these advisors' views are in line with what the curriculum advocates, as they suggest that mathematics should be taught in relation to other activities and alongside student experiences. Though Mrs Walter suggests that students have to be shown ways in which mathematics could be applied, her articulation did not highlight the extent or type of application she could be referring to.

Ms Irene, who had just taken up the new post as a subject advisor a few months earlier, acknowledged that she had not served in the curriculum panel that designed or developed the mathematics syllabus. In line with other officers, she narrated what she thinks this statement could mean:

> *I think, um, what the person is basically trying to say, or the people who came up or set up this, are just to make sure that mathematics is not a local language. And for the teacher to understand or to make the learners understand that-- If you want the kids to understand mathematics and love mathematics you have to use the things that they know, the things that they see, the example that they are used to. That would help them understand better.*

In her articulation, Ms Irene did not only make sense of the statement in a way that suggests how school mathematics should be taught, she also reflects the way she has interpreted what other people have stated. Ms Irene suggests that if students are to love and master this (foreign) language, the teacher has to teach it in a language that children understand and use things that they know. Similar to others, Ms Irene focuses on the benefits attached to strategies that would follow the declamatory statement. She believes that for the teacher to make learners understand and love mathematics, teachers need to use what learners know, see and what they are used to. Ms Irene's reference to 'understanding' hints at the introduction and/or development of mathematical meanings. From her articulations, it appears as if she gives the impression that recruiting contexts facilitates meaning-making in mathematics. Meaning could be thought of as a sign which signals that a student has made a tie between the signifier and the signified. These articulations appear to suggest a pedagogic strategy, without mythologising mathematics at the same time.

In the above quote, by mentioning that 'mathematics is not a local language', it is not clear whether Ms Irene just rephrased the word 'universal' to 'not local'. Again, from her statement, ways in which the mathematics language differs from other languages is not clarified. However, attempts to allow respondents to interpret the declamatory statement in smaller chunks led to further revelations, not only on the notion of mathematics being a language but also on understanding how advisors made sense of the statement. In particular, interpreting what the phrase 'mathematics is a universal language' could mean, Ms Jones explained:

> *Based on my own understanding- saying it's a universal language there I want to agree. Because like any other language we have things that we tend to say they are languages only when we talking of local language or second language like English … Oshindonga … Oshikwanyama and so forth. But then, if you look at mathematics itself it's like it has got its own language. Um in the sense that it is not like any other- it is not categorised as a science subject. But then if you look at the science subjects, as they are linked to mathematics you can say it's a big difference. Because um- it's a- how can I say it now. It is a language on itself because looking at how we are teaching it, one need to understand the language*

and the terminologies that are used in mathematics. Um … unlike in some subjects where you can just memorise then you-- you can pass the subject. But, here it requires a full understanding of um those concepts which are used.

In her expression, Ms Jones seems to clearly explain why she perceived Mathematics to differ from other languages such as English and Oshindonga. She also seems to draw the supposed boundary between Mathematics and other subjects such as Environmental Studies or Biology. In line with what Dowling (1998) suggested, she appears to recognise that mathematics has a grammar that is unique to itself. Ms Jones appears to imply that concepts that are unambiguously mathematical need to be understood by the learners of mathematics, and that teaching should not encourage their memorisation.

The first three advisors (Ms Botham, Ms Irene and Mrs Walter) appeared to have interpreted the statement in a way that promotes incorporation of the everyday in mathematics, particularly the inclusion of local flavour. Unlike the other three, inferring from this quote, Ms Jones does not seem to make this explicit. However, different from the other three, Ms Jones pointed to an important aspect that school teachers might need to be aware of. Mrs Walter believes that teaching students mere computations without involving the application of such computations to students' lives could compromise student's understanding of the subject and the reasons behind studying it. Inferring from these interpretations, it is possibly sufficient to conclude that guidance given to mathematics teachers encourages links to students' daily life as the curriculum demands. Ideally, from these responses, one could sense the appreciation as well as the prominence the statement seems to have among subject administrators.

Findings on how subject advisors made sense of the declamatory curricular statement have been presented above. Subject advisors guide school mathematics teachers, and oversee the proper implementation of the mathematics syllabus and that subject policy is followed. If subject advisors construct particular myths, it is likely that mathematics teachers would do the same. The hypothesis was that if subject advisors' articulations are dominated by the myth of reference, myth of participation, and the myth of emancipation, it would be likely that teacher practices will also be dominated by either one of the myths, two of the myths, or by all. The myth of emancipation could also be interpreted as a special myth of participation (see Chapter 4). Findings on how teachers made sense of the same statement will be presented next.

5.2 How mathematics teachers made sense of the declamatory curriculum statement

Teachers made sense of the declamatory curriculum statement in ways that were more divergent than their subject advisors. Figure 4 summarises four ways in which teachers made sense of the statement and highlights the divergence of those articulations. Teacher articulations from which Figure 4 was derived are also presented next.

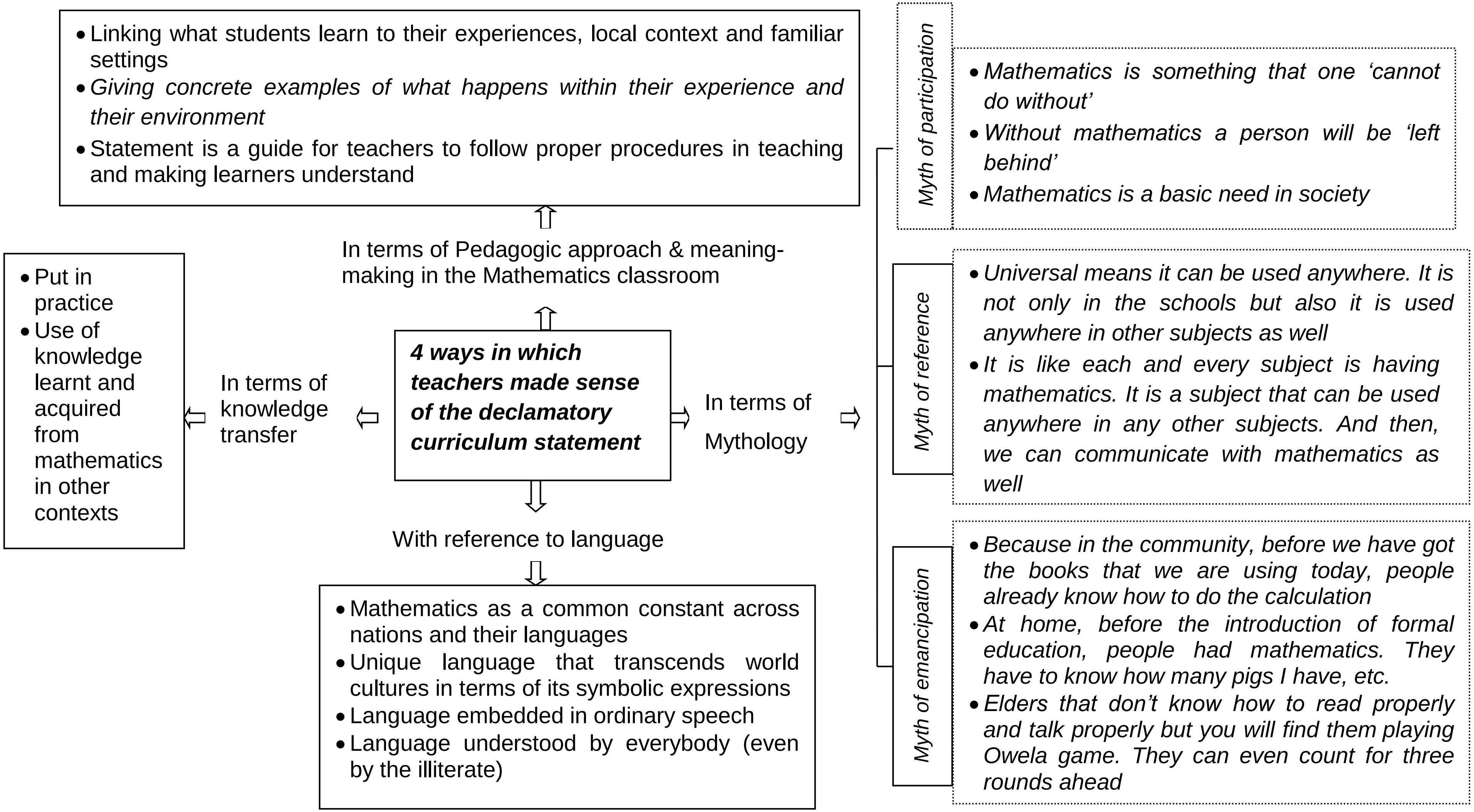


Figure 4: Four ways in which school mathematics teachers made sense of the curriculum declamatory statement

5.2.1 Teacher interpretations as mythologising

Similar to subject advisors, some of the teachers' utterances pointed to mythologising mathematics in particular ways. In the same way, teacher's constructions of the myths of participation, reference or emancipation are illustrated with instantiations from the data. Again, this is done with the purpose of highlighting how the analysis was arrived at in Figure 4.

(i) Interpretations that suggest the myth of participation

Similar to what emerged in Section 5.1, teacher articulations that suggest the construction of the myth of participation is given in various expressions. These include statements such as mathematics is something that one 'cannot do without', that without mathematics a person will be 'left behind', and that mathematics is a basic need in society. For example, in the process of interpreting the statement, Mr Pandu made the following remark:

> *I do not really understand it but the way I understand it, I think that it is something that you cannot do without. Yeah. It is like a basic need in a society. It is being used in most of the subjects and real-life activities.*

Mr Pandu seemed to assume that the statement is there to promote the image of mathematics or what mathematics is understood to be. Not only did Mr Pandu construe mathematics as a basic need in society but he also perceived it as a tool used in other subjects and other real-life activities. The perception of mathematics as something that one cannot do without implies that an individual needs it no matter what. Hence here mathematics is not so much constructed as being potentially about itself; rather, it is essential for achieving something else. This implies the myth of participation. In further articulations, Mr Pandu constituted mathematics as a language, and that a person who does not know this language of mathematics is 'left behind' with many things that are happening in life. Here, it appears as if mathematics is constituted as a language, and this language is incorporated into 'everyday' practices so that an individual who lacks this language (mathematics) is effectively 'handicapped' by their own ignorance:

> *Well, I think it means that mathematics is a language that um- is a language that applies to all the things that are happening in life. That means if the person who does not know mathematics that means that um that person will be left behind with many things.*

Mr Pandu's remark parallels a remark made by Bridgid Sewell in 1981 (Sewell, 1981, cited in Dowling, 1998, p. 9). Sewell remarked that those who lack the skills even to calculate 10% are handicapped when attempting to understand the affairs of society. While it may have some truth for a range of situations in which percentages are important, Dowling (1998) pointed out that people are often pathologised as lacking mathematical experience or knowledge without considering that in many daily activities, provisions are made to the extent that the actual calculations would not even be necessary. Still, the fact that mathematics is an operational tool utilised in other diverse practices is undeniable.

(ii) Interpretation in a way that suggests the myth of emancipation

How teachers made sense and talked about the statement also somehow pointed to the myth of emancipation. To avoid repetition, the same instantiations presented in the previous chapter, under Section 4.5.1, will be used. These were three examples from three different teachers that point to the myth of emancipation. In Section 4.5.1, Mr Vatuva, for example, made the expression that mathematics existed even before the introduction of formal education. Equally, Mr Handje concurred with Mr Vatuva that mathematics existed in communities even before the introduction of mathematics books being used today. Mr Handje even believed that it is that community knowledge that curriculum designers drew upon to come up with the mathematics syllabus used nowadays. Mr Kafula concurs with the other two teachers while emphasising that even the illiterate were able to count while playing traditional games.

The myth of emancipation propagates the idea that by making people aware of the mathematics they are using in their cultural practices, one is empowering them and making them less ignorant, thereby emancipating them to a better life. Though the idea of empowerment and emancipation is not explicitly quoted in these teachers' utterances, the fact that teachers perceived mathematics as inherent in cultural practice (such as games) before the introduction of formal education and curriculum materials (such as books) could be taken as propagating the myth of emancipation.

(iii) Interpretation in a way that suggests the myth of reference

In the process of interpreting the statement, Ms Olivia made a remark that could be regarded as a version of the myth of reference:

> *I just want to start with mathematics is a universal language. Something which is universal means it can be used anywhere. It is not only in the schools but also it is used anywhere in other subject as well. Mathematics cannot just be used specifically, but in Physics there is mathematics, in Geography there is mathematics, in History there is mathematics. It is like each and every subject is having mathematics. It is a subject that can be used anywhere in any other subjects. And then, we can communicate with mathematics as well.*

In this comment, it appears as if mathematics is not only about itself but is also about other school subjects and is for communication as well. Based on its prevalence, mathematics appears to have accorded itself a universal distinctive attribute and descriptive power over other subjects and activities.

On the other hand, Ms Olivia seems to construct mathematics as a distinctive practice, but one whose values can be exchanged for other practices. By stating that ‘mathematics cannot just be used specifically’ but in other subjects as well, Ms Olivia appears to assert differentiation between different fields of studies. According to Dowling (1998), it is only the myth of reference that maintains a distinction between activities. Ms Olivia appeared to be establishing a division between mathematics and other subjects (e.g. History, Biology) and constitutes the former as generative of commentaries upon the latter. Ms Olivia seems to have realised that mathematics has its own principles of recognition and realisation that enable it to service other activities. This could also be interpreted as meaning Ms Olivia constructed mathematics as a system of exchange-values, and that its commentaries can be exchanged for other academic subjects.

In constructing the same myth and similar to what is observed in subject advisors’ interpretations, Ms Olivia below appears not to draw a distinction between mathematics activity and non-mathematics activities.

> *The application is the uses. For them to make use of that mathematics. When they are doing something at home, at least they need to be aware that this is the mathematics I am doing, not just something without any knowledge that this is mathematics. Even by making tea. How many spoons of sugar do you put in the tea? That is the mathematics they are using.*

For Ms Olivia, making tea is indeed doing mathematics. Seeing mathematics in making tea seems more like the myth of reference, that is, mathematics is being used to refer to and describe an extra mathematics practice.

Apart from interpreting the statement in terms of myths, teachers made sense of the statement in other ways, separate from the construction of myths. These are interpretations made concerning language, in terms of meaning-making and regarding knowledge transfer. These themes are discussed next. As in Section 5.1, instantiations from the data are used to demonstrate ways teachers made sense of the declamatory statement.

5.2.2 Interpretation with reference to language

While showing how they make sense of the statement, teachers made explicit reference to 'language' in different ways. Such reference was afforded as 'universal language' was part of the wording in the statement that was used as a prompt. All responses that made reference to language in different ways were grouped together and then differentiated. Depending on how they made reference to language, sub-categories were identified. Overall, an interpretation that was made in terms of language referred to how the language of mathematics is spoken everywhere and throughout other languages, and how that language is used everywhere and understood by everybody. Next is a discussion on how teachers made sense of the statement in these respects.

(i) Mathematics as a common constant across translations

The statement, particularly the phrase 'universal language', was interpreted by teachers as talking about mathematics as being a language that transcends nations of the world irrespective of the language people in those nations speak. For example, Mr Handje explained it this way:

> *About the statement that mathematics is a language, um I know and I am understand that mathematics it is the subject which um- even the language which can be all over the world. Um, because wherever you are, people can count by using the numbers, just only the natural number as they are.*

Mr Handje perceives mathematics as a common constant across translation. By common constant, the teacher could mean a mathematics that remains the same irrespective of the language or nationality. Mr Handje has the notion that mathematics is a universal content that translates into all other languages. While doing this, this teacher appears to separate the language from the mathematics or the signifier from the signified, the latter ('the natural number') being constant across practices in which mathematical concepts are used. Mathematics is seen as an unvarying aspect so that irrespective of people's background, they all count with natural numbers.

In addition, Mr Handje construed mathematics as a language that is separated from a universal mathematics that exists independently, and which can articulate itself in different languages. While this view might be common, such a separation can be contested, as mathematics is only done in a language. As Barton (2008) proposed, the form and structure of this language do not keep the meaning constant.

Similarly, one of the teachers, Ms Longa, interpreted the statement in terms of a language that has universal numbers and letters that are used in communication.

> *Um, they mean that mathematics is um, it is also a language itself. It is a universal letters. All the people they can communicate with um using numbers. Even if they have different languages whenever it comes to the number all, we can be able to communicate.*

Ms Longa suggests that even though people have different spoken languages, they all communicate using numbers, 'letters' possibly referring to universal usage of number signs.

Similarly, teachers interpreted the statement in terms of using similar symbolic expressions irrespective of the tribes and languages spoken. Ms Dorkas explained:

> *Mathematics is a language on its own. So you don't have to have a certain language for you to understand the mathematic language or the subject. No matter how mixed the tribes are or linguistics are, as long as you introduce that mathematics, number is just a number. So it's how I understand if they are saying it's a language. I think they have explained it so well because it's just like I said. Number one, if you are to write number one in Afrikaans like a numeral it's just one, in English it's just one, in Oshiwambo it's just one. So there is no way that they changed the shape and so on. With the learners I think it's easier to study it even if you are only taught English here in Namibia and you happen to study in China the number is just a number.*
>
> ***I:*** *You mean the number as a symbol?*
>
> ***NG:*** *Yes, in symbols like numerals, not in words.*

It is true that even though some dialects have no specific names for numbers, numerals have spread all over the world. Just like the English language, mathematics symbols have spread too. While the argument that a number symbol cannot change its shape cannot always be true, spoken systems of numerals differ in any case, even in their construction. Perhaps the case may apply if Ms Dorkas is referring to some languages within the same country. For example, in Namibia, if she is referring to numerals in different local languages (like Oshiwambo and Afrikaans), symbolically, they both use Arabic numerals, although pronunciations and scripts differ.

(ii) Mathematics as a language that is embedded in ordinary speech

Some teachers believed that the concept of universality in the statement implies that mathematics is everywhere, and that it is even part of everyday communication. Ms Olivia explained:

> *Even the language itself can be used in mathematics. Somewhere somehow we may use the mathematics there. Where are you coming from? I am coming from two kilometres away.*

Even though one might think of mathematics as done in a language, Ms Olivia appears to state that language can be used in mathematics and at the same time one is using mathematics in language. Hence, there cannot be a clear distinction between ordinary language and mathematics; one might infer from the example.

(iii) Interpretation in terms of language that is understood by everybody

Others perceive the statement as referring to basic mathematics as a communicating device. One of the teachers, for example, mentioned that the statement means that mathematics is a language people speak every time, is spoken everywhere, and understood by everybody. For example, Ms Feni made the following remark:

> *Aam there I think what they mean is aam, is a language which is being used throughout by others in um- and which can be understood by everybody.*

The claim Ms Feni is making is that all the people can communicate using some mathematics. Similarly, Mr Vatuva stated:

> *Even somebody- the lowest person in the society understands the language of maths because he wants to know how much do I have. On the other extent, if we go across the border to other countries, the same language of mathematics is understood by everybody. We can talk different languages, but when we come to calculations of math, we are the same.*

Mr Vatuva made reference to social status (such as poverty) and to the necessity of being able to count in order for someone to determine how much one has, again referring to economic indicators. These types of assumptions might also find their way in pedagogic interactions. Generally, equal positions in an activity cannot be assumed because there can be buyers and sellers for example, or those who want to make profit and those who want to minimise expenditure. Mr Vatuva appears to suggest that mathematics helps to cross social as well as cultural boundaries so that 'we are the same'.

5.2.3 Interpretation in terms of pedagogic approach and meaning-making

Articulations that were made in terms of teaching approach to mathematics in order to facilitate understanding were also assembled together. Those who made reference to meaning-making includes those who interpreted the statement in terms of using concrete materials, establishing associations between school and home activities, and drawing upon environment and communities to facilitate a leaner's understanding. To begin with, some teachers interpreted the statement in the light of pedagogy that links what students learnt in school with their everyday lives, particularly to illuminate concepts. For example, Ms Longa stated:

> *Yaah, it means that whenever we are teaching mathematics we have to link with everyday life. When the learners knows they can be able to explore. And also, we have to link with their experience with the concepts in mathematics.*

Ms Enkali echoed:

> *So the way I understand is like, when we are teaching mathematics we are normally referring to normal everyday life. Practical things that are happening they are all talking about mathematics.*

In line with other teachers, Mr Vatuva explained that the statement is there to ensure that teachers followed proper procedures while teaching mathematics.

> *It (the statement) is introduced in the mathematic syllabus so that whoever, the teachers when they are teaching they have to see to it that they are following proper procedures for the understanding of the learners. If teaching does not consider the level of development that's why sometimes we regard mathematics as a very difficult subject. Because we try to drive in some concept which are far above the children's understanding. That's why just like when you are talking of grade 1 they rely most on concrete.*

Further, Mr Vatuva explained that the statement suggests that the teaching content itself should be based on local context, and that teachers have to give concrete examples based on what is happening within the students' environments:

> *To contextualise, it means to understand. So, it means mathematics should be taught within the children to experience in their local environment. That will make them understand it better because it includes the language used. That is in context of their language, in context of their culture that's how mathematic is used. So, there is no way you can bring a concept to somebody in a different language and a concept is understood. For the concept to be understood well, it must be in somebody's language and it should be given in an example of his local environment. That is to contextualise. Then somebody will understand very well.*

Similar to many other teachers, Mr Vatuva felt that the statement implies that when teaching begins, it should make use of locally available examples based on where students live and should also take their language into account. As he was also referring to developmental appropriateness, this is a pedagogic approach. In line with this, Mr Vatuva also suggested that this calls for teachers to familiarise themselves with the local cultures and the type of life students are living:

> *We have to understand that before the teacher takes up the situation, the teacher must have the knowledge of the local. That is the type of life those people are living, their culture. So that it will make their life easier for the teacher by giving concrete examples of what happens within their experience and their environment. We cannot talk of going to the circus in a very rural area where they don't know what a circus is. There are 10 people at the circus; they don't*

> *know about a circus. So if you say there are 10 people in the Mahangu field, then you are talking of the example which they know really.*

Omahangu is one of the local staple foods grown in the area where the school is located. Concurring with Mr Vatuva, Ms Feni justified the benefit from teaching that fetches on what students know:

> *Learners will only know what they are doing it if we are applying it in the things which we are doing everyday, which are around them. Like including the objects or the things which they are doing, which can be things which they have at home.*

Examples presented by these teachers reveal what the statement meant to different teachers, the benefits of an approach based on what it carries, and how they generally perceive mathematics should be taught. This seems to concur with what the syllabus demands. Apart from those discussed above, the statement was also interpreted in terms of knowledge transfer, and this conception is presented next.

5.2.4 Interpretation in terms of knowledge transfer

The statement was also interpreted in terms of transferring acquired knowledge across contexts. For example, some teachers talked about the ability to work with numbers and solve problems. Some pointed to the need to help students understand how to use the mathematics knowledge acquired at school in other contexts. For instance, explaining the concept ‘application’, Mr Vatuva articulated:

> *When we say application let’s say to understand how to use it. That is, a concept and then application. I borrow $10.00 from you. Then I say I need to use that money. Before I return the money to you, you have a problem also. Then in general I take something also which you are selling for $3.00. This means now I owe you $13.*

Mr Vatuva appears to understand the term application as meaning to learn about where to use specific aspects of mathematics learnt at school. As an example, in this case, Mr Vatuva understood the term application in terms of transferring learnt knowledge from mathematics to the economic practice of buying and borrowing money. According to Mr Koto, students can even apply mathematics knowledge while engaging in leisure activities:

> *Application may be is to put it in use. What it does mean here, may be to apply. What they learnt they can also apply in different ways. Maybe when they are playing there. In that way, they can understand it better.*

In this case, one could say that for Mr Koto, the term application refers to the transfer of school knowledge to other contexts such as leisure activities. On the other hand, Mr Koto felt that applying mathematics while at play is another way of enhancing students' understanding of mathematics. Mr Kafula's response is in line with the other two teachers. One of Mr Kafula's sense of the statement was that the term 'application' and perhaps the statement as a whole calls for students to put into practice whatever they learn in mathematics:

> *It means you have to put it in practice. If it is possible, let them practise what they have learnt. Let them use it and try it where it is working, whether it is working.*

Above, four ways mathematics teachers made sense of the statement were presented. Additionally, findings on how mathematics teachers and their subject advisors made sense of the declamatory statement in the discussion that was linked to the interpretation of the text used as a prompt were also discussed. Other ways in which both talked about the statement and the subject of linking mathematics and the everyday will now be dealt with. After presenting general suggestions made by the advisors, findings concerning teacher familiarity and cognisance of the declamatory statement will be presented. Examining data in this light was prompted by earlier findings from subject advisors who alleged that teachers normally confess that they do not read or take into account such statements. Generally, the findings in this section might be useful for informing specific teacher education policy.

5.3 Further findings from advisors' articulations

The findings from subject advisors presented earlier constituted an analysis of the data in the light of the categories of Dowling (1998) of mythologising (school) mathematics. An attempt was also made to ascertain what else the data would yield in terms of the ways in which subject advisors speak about the declamatory statement. Other themes and references that were made will be disclosed next.

Advisors did not only make sense and talk about the subject directly indicated by the curriculum declamatory statement. Other suggestions were made, relevant information and sentiments were disclosed, and speculations and accusations also ensued during the interviews. These findings are summarised in Figure 5. Instantiations that explain Figure 5 are also presented after the figure.

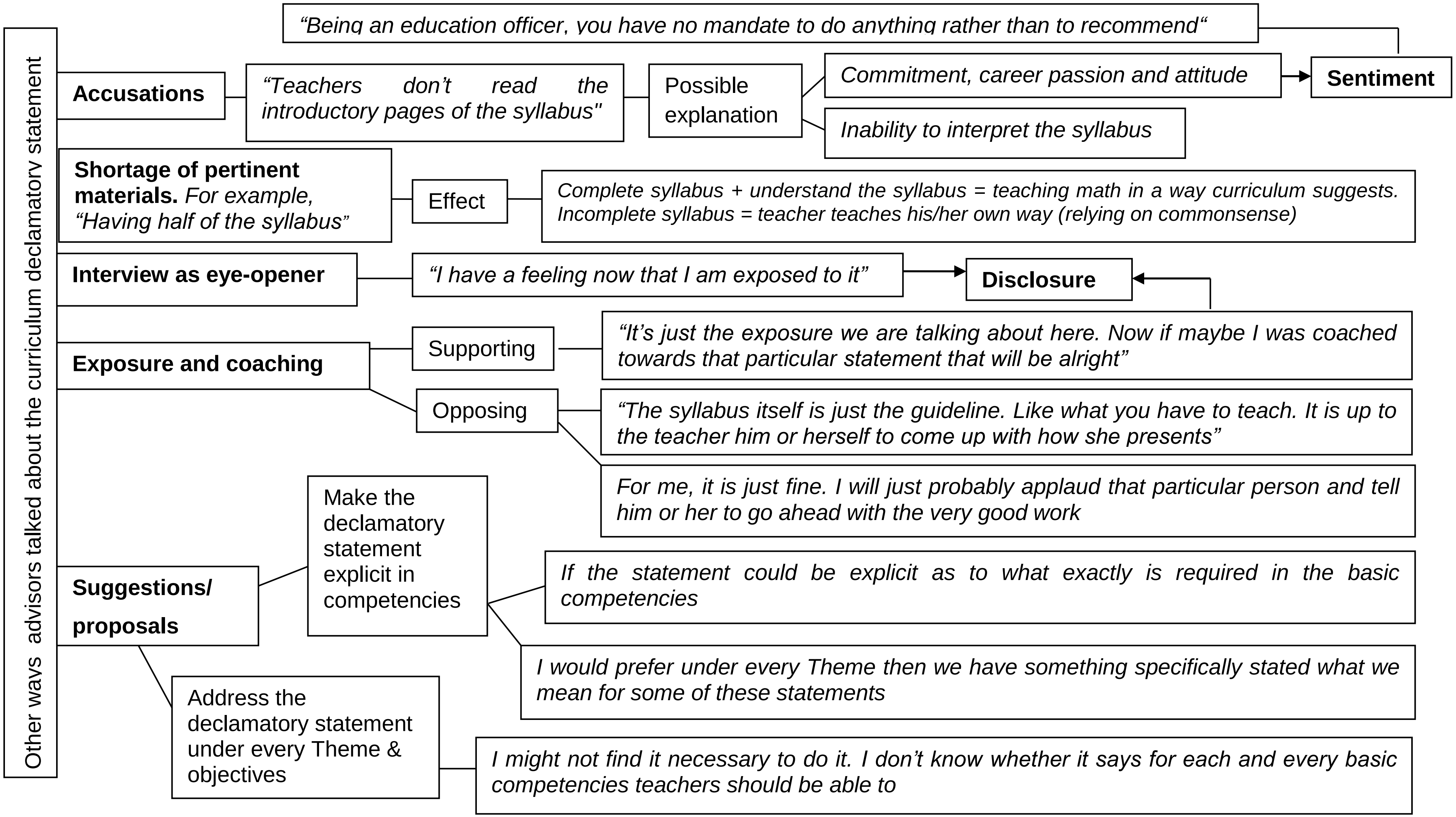


Figure 5: Other ways subject advisors talked about the curriculum declamatory statement

5.3.1 Subjects advisors' views about teachers' engagement with the curriculum

Although the curriculum declamatory statement implies a teaching goal and/or a pedagogic approach, subject advisors contended that some teachers do not read the declamatory statement or pay attention to it, and some teachers do not even consider the introductory pages of the syllabus. Mrs Walter, for instance, said that teachers themselves confess to her that they do not read that statement, or more generally, the introductory part of the syllabus. The following quote by Mrs Walter highlights this accusation:

> *They confess. They confess to me that I have never take time to read this.*

Ms Botham observed a similar habit or trend. While she perceived it as a big issue, she doubts whether this is a matter of ability to interpret the syllabus:

> *It is a big issue. I do not know whether it is the interpretation because most of our people, what I realise, have never read the first part of the syllabus. They go straight to the learning objectives and teach. From experience, that is what I realise.*

Mrs Walter offered a different speculation. She suggested that it is something that has to do with commitment, career passion, and attitude:

> *Normally at the beginning of each year, we have this novice teacher workshop where we are highlighting all these issues for them to go in with open mind and open eyes about what are the issues we have. But we have other people who are just there as long as the salary comes. Not really passionate about the subject and teaching. It is very disappointing and you go to school and you were there last year and do some recommendation and show a person how to do things. And coming back after some months, it is the same story you are recommending again. Being an education officer, you have no mandate to do anything rather than to recommend.*

There could be many reasons that explain choices teachers make respecting teaching and learning of school mathematics. At the same time, this revelation not only suggests that subject advisors are already aware of what is happening regarding declamatory statements and their influence on teaching but also implies that advisors consider those statements as a significant part of the syllabus and beneficial to the teaching of mathematics.

There were other pedagogical issues that were more pressing for Mrs Walter. She further revealed that at times teachers do not even have the complete syllabus. She believed that since the statement is under 'approach to teaching and learning', where teachers are guided on how to teach the subject, if a teacher does not read that statement, then they will end up teaching mathematics their way. This was highlighted in the following expression:

> *If the teacher have a syllabus and the teacher understand the syllabus, then the teacher will teach math in the way the Namibian curriculum suggest. But if teacher have the syllabus- half of the syllabus- and that is what I have seen in many schools. Because in many schools you go there, the teacher is having only part or a section of the grade he is teaching which is the basic competencies. Then that teacher will teach mathematics without knowing what the Namibian mathematics is supposed to be taught. So you are teaching mathematics your way but not the way we would like mathematics to be taught in the classroom. And those are the many cases- most of the cases we have found.*

This frank disclosure presents another speculation that could make teachers not to consider declamatory statements. Significantly, without relevant materials and necessary support, it also raises the question as to what extent mathematics teachers have to rely on commonsense as far as bridging mathematics and the everyday in a mathematics classroom is concerned. Some of the pedagogic issues that advisors perceived as pressing as far as this declamatory statement is concerned have been presented. Their opinion on what they saw as the advantage of having taken part in the interviews will be revealed next.

5.3.2 Interview as an eye-opener

Prior to the interview sessions in which the curriculum declamatory statement was discussed, it appeared as if some of the subject advisors were not fully engaging with the introductory pages of the mathematics syllabus and with the declamatory statement in particular. One reason was that not all of them were part of the curriculum development committee. However, even though some advisors were aware of the existence of the statement, some of them admitted that, before, they never considered it in a way they think about it after the interview session. Specifically, the issue of exposure was emphasised, and this was how Ms Jones expressed the worth of engaging in this study:

> *Now that am exposed to it. You just said and talked about it. I feel it's more necessary for it to be part of the syllabus. Because we don't teach out of the blue, or we don't- because we have to teach what exactly is in the syllabus. Hence I have a feeling now that I am exposed to it. It might help our learners to pass if they are exposed to it.*

A follow-up on what Ms Jones meant by "now that am exposed to it" revealed that although the idea of bridging mathematics and the everyday was on paper, some advisors never reinforced it unless they were sparked by the learners. Ms Jones talked about how she was induced by her students before she linked the content to the everyday:

> *I was aware of it, but then, the statement itself like I said, I have taught for some years already, but I did not put that in mind like imagine every lesson I should try to link this one. I used to see it at certain point, but only where I see it's necessary or am being triggered by the learners to say why are learning this and not that.*

This response leaves educators with the questions of asking when it is necessary for teachers to consider what the declamatory statements suggest: Is it during each lesson planning process or only when teachers are induced by the learners?

5.3.3 Exposure and coaching on the curriculum declamatory statement

For some advisors, the question of whether one participates in the syllabus development process is necessary, but it might not be sufficient. Though some administrators are aware of the existence of the declamatory statement, some mentioned exposure as an important aspect in engaging with this statement. Ms Jones explains the importance of exposure and coaching as far as the declamatory statement is concerned:

> *It's just the exposure we are talking about here. Now if maybe I was coached towards that particular statement that will be alright. Maybe if that could be something I heard before, then it could have helped.*

While some emphasise the need for coaching, others had contradictory views. Ms Irene, for example, was explicit with regard to instructional guidance as far as the curriculum declamatory statement is concerned. For Ms Irene, a syllabus is just a guide, and it is up to the teacher to come up with what engages the learners and develop their appreciation of the subject. Ms Irene regards the syllabus as a road map which is not necessarily supposed to speak for itself:

> *The syllabus itself is just the guideline. Like what you have to teach. It is up to the teacher him or herself to come up with how she presents this to her kids and to make sure that learners really grasp what is given to them. The syllabus in itself is just a map. It is just a framework. It is just ok.*

While Ms Irene acknowledged that the subject of the study is important, unlike other advisors, she did not feel exposed by it. Ms Irene acknowledges that the existence of the statement in the curriculum means well, and the proponents need to be commended for it. Had she been given a chance to say something to the curriculum developers, she would have had nothing to say because everything concerning the declamatory statement is just fine:

> *Mmm, I do not think I will have much to say. Because is like I said I am- For me it is just fine. I will just probably applaud that particular person and tell him or her to go ahead with the very good work that he/she is doing.*

The aforementioned two quotes from Ms Jones and Ms Irene are meant to highlight different views that advisors have concerning the clarity and importance of the declamatory statement.

5.3.4 Advisors' proposals concerning the curriculum declamatory statement

An important suggestion emerged from the interviews. This has to do with making the meaning of the statement more explicit across the syllabus. Mrs Walter felt that the success of implementation depends on the ability of teachers to interpret the statement. Mrs Walter suggested that this type of statement needs to be addressed in the competencies section of the mathematics syllabus:

> *Um, the curriculum is so but um-- Though it may mean good, it depends on the interpretation of the teacher. Sometimes the basic competency is just short like this, but pregnant. If a person could just see the front cover of that one without teaching deeper, that is where the misinterpretation comes about and affect what is happening. I am thinking, maybe we are suggesting, if the statement could be explicit as to what exactly is required in the basic competencies.*

Probing subject advisors about how they would label this statement, particularly if they would call it a curriculum goal, a teaching approach or any other descriptive name, Mrs Walter could not figure out what it was. However, she had some preferences. She suggested that it could be best if curriculum designers or developers include a definition of what is meant by this statement under every theme. Secondly, her opinion was to have it clear under every theme and assessment objective. She suggested that the meaning be made explicit across the syllabus, particularly in assessment objectives:

> *For me I will say that could be the main aim, but when you go down to the assessment section and there are these assessment objectives which also state clearly what is that we want our learners to have if they have passed a certain phase to know or to be able to do. And that is what we normally assess on. Maybe collectively that is the major umbrella, but I would prefer instead of putting it there. I would prefer under every Theme then we have something specifically stated what we mean for some of these statements. It could be just a statement just there, but not all of us understand what it entails.*

Although the idea of bridging mathematics and the everyday is well spoken about by subject advisors, it appears as if the statement remained elusive to some of them. To some, it seemed not even clear why it is there and whether the statement is put in the curriculum for assessment. The atmosphere seems to be that if the message in the statement about the importance of linking the academic and the everyday is as important as the goal of teaching esoteric mathematics, then this should also be reflected in the objectives, competencies, as well as in the assessment requirements of the syllabus. This could be because when subject advisors visit teachers in schools, they look at the extent to which they assist learners in meeting subject competencies stated in the syllabus. Moreover, teachers do not evaluate results or student performance from the perspective of applications in extra-mathematical contexts. Ms Jones cannot tell as to whether or not this statement is compulsory in every content to be taught. She relates:

> *I don't think it's a compulsory thing to do. Because what we teach- we teach the syllabus, the basic competencies. But it did not like, stated anywhere that you should be able to link this one to real-life situations. Then I might not find it necessary to do it. I don't know whether it says for each and every basic competencies teachers should be able to, but I think somewhere somehow it's indicated that where it's possible maybe you can link.*

These sentiments point to the nature of the tensions some subject advisors deal with as far as the message in the statement is concerned.

5.3.5 Advisors' proposals concerning enactment in the classroom

When it comes to an ideal implementation of the message from the curriculum declamatory statement, subject advisors suggested examples that imply the application of mathematics or some form of modelling of real-life activities. They suggested that teachers should engage in (1) brainstorming while at the same time tapping into learners' experiences, and teachers should (2) recruit familiar activities that students have observed or have engaged in. Among the familiar activities are those that could be classified as imaginative activities.

These opinions about realisations in classroom practice will be present below. Most of the examples mentioned here appear to emphasise simple mathematics applications without making assumptions explicit. However, there was one that suggests modelling activities of school mathematics. Further expansion on ideas about ideal implementation is provided in Appendix 8.

5.3.5.1 Proposed examples that suggest basic mathematics application

Highlighting what brainstorming could be like, Ms Irene suggested these are some of the things teachers could do in their lessons:

> *Asking the learners, you can ask them for example what kind of animals you have around here? How do you cook? Do you collect fruit for example?*

In another instance, Ms Botham suggested also using imagined activities. In referring to those, the teacher used exemplars that signify activities students had engaged themselves in or something that students had observed and experienced. For example, Ms Botham related:

> *If, for example, you are teaching Cones which is a Mensuration, bring something in context. Bring about a child building up their own room. They want to paint the area. They want a perimeter of that room. They want um to tile up the things. Then that makes volume, perimeter and area. So, that will bring about the mensuration which look Latin to them or sound Latin to them. In reality, aam, that is what we do. Traditionally we have these huts. They are normally either square or cylinders. But in the end, you put on this traditional hut itself. Where you thatch ne, if you look at it, it is more of a cone. Then, I always tell them, look around. Everywhere we look is mathematics.*

Ms Botham appears to suggest that students are expected to reconstruct the situation of building huts under the gaze of school geometry, that is, the building of huts has to be interpreted in terms of school geometry by using a shape of a cone. She suggests that teaching could fetch on these traditional activities of erecting these huts. One could also notice that her suggestion is coupled with one of the ethnomathematics views of mathematics ("that is what we do. Traditionally we have these huts. They are normally either square or cylinders …"). Since this utterance appears to point to mathematics frozen in traditional artefacts, on the one hand, this view might signal the myth of emancipation. However, Ms Botham did not say that mathematics will emancipate students from their incomplete cultural understandings. Hence, on the other hand, this view could signal the myth of reference. This is because it seems mathematics is being used to describe extra-mathematical structure. If it is taken to suggest the myth of emancipation, then eventually this translates into 'public domain text' (see Chapter 3). However, if it is taken to suggest the myth of reference, then eventually this translates into 'esoteric domain text'.

5.4 Further findings from mathematics teachers' articulations

An attempt was made to look at mathematics teachers' familiarity with the curriculum declamatory statement. Findings convey the impression that teachers fall into three categories. These include those who are aware that there is such a statement in the mathematics syllabus, those who are unaware that there is such a statement in the mathematics syllabus, and those who are acquainted with the curriculum declamatory statement because they came across some of its concepts or terms somewhere else other than in the mathematics syllabus. Illustrations from each of these groups are presented in Figure 6, as well as in the text that follows.

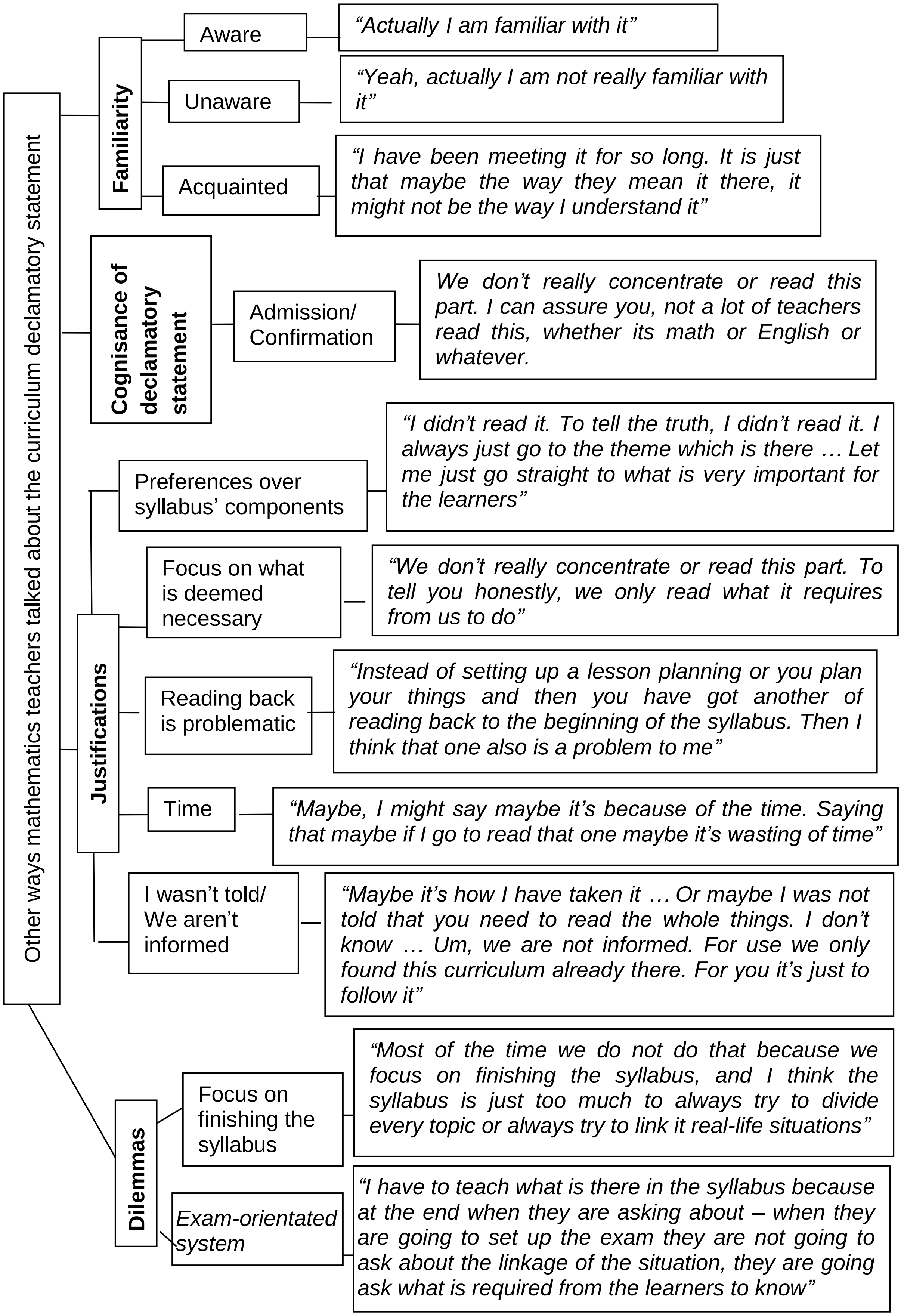


Figure 6: Other ways in which mathematics teachers talked about the curriculum declamatory statement

5.4.1 Awareness, unawareness and acquaintance with the curriculum declamatory statement

Those who are aware of the declamatory statement showed a sign of having knowledge of the existence of the declamatory statement. This group of teachers did not hesitate to say how they made sense of the statement as soon as it was presented to them. Those who are classified as being unaware were those whose responses showed signs of not knowing the existence of it. These respondents were either not familiar with the statement, or they were coming across it for the first time. For instance, Mr Sakeus admitted:

> *Yeah, actually I am not really familiar with it. I do not really want to say much about it because I am also not sure.*

Similarly, Mrs Martin remarked:

> *It's for the first time to hear. Maybe I'm not- I'm not going to answer that one, sorry.*

The category of acquaintance assembled expressions that show signs of having come across the statement somewhere else other than seeing it in the syllabus itself. For example, Mr Pandu responded that he appeared to have come across some of the terms in the curriculum declamatory statement during his years of teacher training.

> *I have been meeting it for so long. It is just that maybe the way they mean it there, it might not be the way I understand it.*

Generally, there were teachers who were confident and seemed to be sure of what the statement means. There were some who indicated that they have no idea of what the statement means, and there were some whose responses have shown a sign of doubt.

5.4.2 Cognisance of the curriculum declamatory statement

Cognisance here refers to whether or not teachers consider or take into account the declamatory statement in their actions, particularly during their planning of lessons. One of the teachers, Mr Getrud, for example, claimed that him and probably other teachers do not usually pay attention to declamatory curriculum statements. Mr Getrud admitted:

> *We don't really concentrate or read this part. I can assure you, not a lot of teachers read this, whether it's math or English or whatever.*

If it is really the case that teachers do not consider these types of statements, one could ask, why are these statements present in the mathematics syllabus? Do such statements matter?

Another question that could be raised is whether teachers' ways of incorporating the everyday is necessarily influenced by the presence of this statement in the syllabus.

5.4.3 Reasons for not considering the declamatory statement

There was a range of justifications given as to why some teachers do not pay much attention or no attention at all to the foregoing curriculum declamatory statement. Discussions as well as the instantiations teachers made concerning them are attached in the appendices (see Appendix 9).

Some of the reasons teachers do not consider the declamatory statement have to do with teacher preferences over a syllabus' components. Reading the statement is constituted as a problem. Some reasons are attributed to weight of the syllabus, the exam-orientated system (and consequently a teaching to the exam tendency) and administrative pressure, time factors, lack of continuous professional development, lack of interest and understanding, feeling that teachers are not either informed or encouraged to do so, as well as feeling that it is probably not necessary to take it into consideration.

5.5 Conclusion

Overall, this chapter presented findings regarding ways both mathematics teachers and their advisors made sense of the curriculum declamatory statement. It also presented other aspects that emerged from the interviews. Generally, it appeared as if both advisors as well as teachers make their own individual sense of what it means to link academic mathematics to students' experiences and skills. The views of the teachers, however, appeared more diverse. The construction of myths revealed a tendency towards the 'myth of participation'. Also, the examples given by most participants appeared to be mostly relating to elementary mathematics. Further, there appears to be teachers who were unaware of the existence of the curriculum declamatory statement or did not feel that introductory sections generally are of relevance to their teaching activities. The detailed reasons were considerably diverse. The degree of autonomy teachers see for themselves varied accordingly. Altogether, there were not many critical comments, and it is reasonable to conclude that all participants appreciated the idea reflected in the statement.

The chapter that follows will give attention to teachers' practices of bridging school mathematics and the everyday.

6 Teachers’ practices of bridging school mathematics and the everyday

The preceding chapter discussed school mathematics teachers’ and subject advisors’ sense of bridging mathematics and the everyday. This chapter begins with a description of two teacher practices including examples of concepts such as signifier and signified. Examples of drawing on the everyday are presented and discussed. The concepts introduced will be used further in this chapter. Instantiations from the classroom interaction data are used to illustrate the modalities of incorporating the everyday in the mathematics classroom by teachers and to demonstrate what happens in some classrooms when teachers attempt to bring abstract mathematical science closer to their students’ experiences. Section 6.2 highlights some of the demands teachers come across while bridging the academic and the everyday. Section 6.3 shows the beginning of a detailed analysis of a mathematics lesson, describing their structures according to didactic function, time allocation per episodes of text. Section 6.4 illustrates how episodes of texts were coded and categorised in various domains of actions. Section 6.5 demonstrates how the nature of the analysis employed led to the identification of the patterns of teacher practices. Section 6.6 discusses what appeared to be a drawback in using the DAS scheme to understand teacher practices of recruiting the everyday in a mathematics classroom. Section 6.7 presents parallel domains to those identified by Dowling (1998). Then, Section 6.8 indicates pedagogic metaphors and multilateral signification used by some teachers while incorporating the everyday in mathematics. Finally, the chapter presents other versions of the expressive domain and highlights the student possibility of relating with and benefiting from these domain strategies.

6.1 Preface to teacher strategies of incorporating the everyday in the mathematics classroom

Two learning points emerged from the interviews: first, ways in which the respondents interpreted the curriculum statement, and second, the way in which respondents talked about the curriculum statement and the subject of drawing on the everyday. Among teachers’ responses, the meaning of the statement was associated with the ways in which mathematics is to be presented to students in the classroom. According to subject advisors and a number of teachers, the statement suggests that learners need to be taught mathematics in ways that link with student experiences. Teaching has to draw on familiar things that students know, as well as on activities they engage in. Based on this idea, teachers appeared to have worked out ways to draw on the everyday. As a result, teachers at times – aided by students – invented and recruited a series of metaphors narratives and incidents that they thought would facilitate students' understanding of mathematics. As set out by Dowling (1998), these narratives consisted of signifiers that point to the signified. What is meant by the identified signifiers and the signified will be demonstrated in the next subsection with the episodes taken from one of the teachers' lessons. A copy of the lesson is attached in Appendix 11.

6.1.1 Defining the concept perimeter: the signifiers and the signified

This episode of text is taken from an introductory session of the lesson that was given to grade 8 students:

Excerpt 1

T *(proceeds): Iyaa. So, today we are going to look at the perimeter. Look at the perimeter. Who knows what a perimeter is?*
Ss: *[silence]*
T: *What is a perimeter? Mh.*
Kaino: *It is a distance around the shape?*
T: *It is a distance around the shape. What about you?*
What do you say? Mm?
He said it is a distance around the shape.
Ben: *[silence] [pause]*
T: *That is the statement. Or someone can say. The perimeter … the perimeter is the line that eem- Iyah. As I said in the previous lesson that people measurement is very … very important. It is playing a major role. Ee?*
Ss: *Mmm*
T: *Now … I said the perimeter is a line which forms up a boundary. Or is a distance around the object … isn't?*
Ss: *Yes*

In this episode of text, Mr Kafula taught about the mathematical concept of perimeter. He defined the term 'perimeter' as 'the line which forms up a boundary' or 'a distance around the object'. In this way, Mr Kafula introduced two metaphors: 'line of boundary' and 'distance around the object'. The two metaphors are signifiers which point to the mathematical concept of a perimeter. The teacher's definition of a perimeter (i.e. 'a distance around the object') is close to the student's (Kaino's) definition (i.e. 'a distance around the shape'). Both of these are metaphors used to express a mathematical content (perimeter). Both of these elements are aimed at communicating the mathematical concept of perimeter. There is a weak institutionalisation in terms of expression and strong institutionalisation regarding content. In line with Dowling (1998), this piece of text qualifies to be categorised as the expressive domain text.

6.1.2 The teacher's attempt to move closer to students' familiar experiential realities

After defining the perimeter as a line which forms up a boundary, or a distance around the object, Mr Kafula posed the next question, this time making an attempt to move closer to students' familiar experiences by drawing on the everyday:

Excerpt 2

T: *Ok. Let me ask you before I go further. What do you think is the perimeter of the school?*

Ss: *[silence]*

T: *Ee?*

Ss: *[silence]*

T: *Mm?*

Tom: *The perimeter of the schoola [sic]?*

T: *Ee. Is what? Ee?*

Tom: *Five per cent.*

T: *Wo wo wo wo. I did not ask you to calculate anything. I said that – what I want you to understand and to know is this. Perimeter. Ee?*

Saima: *A perimeter oku dja apa to yi ngaha fiyo o papa.* *(A perimeter is going this way starting from here up to here) [Saima talks to her seatmate].*

T: *So we said the perimeter is a distance around the?*

Ss: *Object*

T: *Object or the?*

Ss: *(( ))*

T: *Which means now if we are talking about the perimeter of the school we are talking about the?*

Sem: *Measuring the distance of the/*

T: */Of the what? Of the?*

Ss: *Fence*

T: *Fence of the school. You have to refer to the fence of the school. Are we together?*

Ss: *Yes*

In this episode, the teacher attempted to recontextualise a context that is familiar to students by asking what students think the perimeter of the school is. However, the students kept silent for a while. One student, Tom, appeared to be surprised by the teacher's question and asks: 'The perimeter of the schoola [sic]?' Mathematically speaking, the perimeter of a two-dimensional shape (such as the perimeter of a rectangle) is usually defined as the continuous line forming the boundary of a closed geometrical figure. Mr Kafula's question of the perimeter of a school might have been confusing to some of the students because a building is a three-dimensional object. This incident highlights some of the complications associated with the process of bridging the academic and the everyday in a mathematics classroom.

Saima, one of the students, also relied on the recontextualising principle by opting to switch to the local language in order to facilitate the explanation of what the perimeter is to her seatmates. To get the perimeter of the school, students felt that one has to measure the fence of the school. A fence is also not a line. Mr Kafula affirmed the student's proposal by responding 'you have to refer to the fence of the school'. Once again, the term 'fence' of the school is used as a metaphor to signify the mathematical concept of perimeter.

6.2 Demands of bridging the academic and the everyday in a mathematics classroom

After telling the students to refer to the fence when conceptualising the mathematical concept of a perimeter, Mr Kafula attempted to come even closer to students' life experience. Drawing on the everyday once again, Mr Kafula posed another question: What is the perimeter of your house? After a moment of silence by students, the teacher rephrased his question, and at some point, switched to one of the local languages. The interaction proceeded as follows:

Excerpt 3

T: *Ok. What is the perimeter of your house?*
Ss: *Perimeter?*
T: *Ee? (( )) Ee?*
Ss: *[silence]*
T: *If the perimeter of the school is that fence which divides the school from the other side … can you see now?*
Ss: *Yes*
T: *Which means now that – that fence if you cross it then um o wa ya monhele yamukweni, hasho?*
(It means now that – that fence if you cross it then you are in somebody's place/territory, isn't?) Ee?
Ss: *Yes*
T: *Now … what do we call the perimeter of your house?*

Heita: *Sticks*

T: *Ee?*

Heita: *Sticks*

T: *Sticks?*

Heita: *Yes*

T: *Of the house?*

Heita: *Yes*

Lukas: *The building.*

T: *The building?*

Lukas: *Yes*

T: *Now is when you are at the rural areas or at the urban areas?*

In towns or in rural areas?

Lukas: *In towns*

T: *In towns?*

Lukas: *Yes*

T: *So you mean the building is the perimeter?*

Lukas: *Silence*

T: *Osho wa hala kutya? (Is that what you want to say?)*

Lukas: *mm (yes)*

T: *Ee?*

Nera: *It is true.*

Ben: *Oh*

T: *Ee?*

Sara: *It's a wall.*

T: *Ee?*

Sara: *It's a wall.*

T: *Is a what?*

Sara: *A wall*

T: *A wall? Ok.*

Setson: *A wall is a ((building)).*

T: *Aa a. (No … no). Building and a wall? Now she is referring to the wall that separates their plota [sic] from the neighbour's plot. Are we together? So people, it is always necessary to do what? Ee? To know how to find a perimeter. Hasho (isn't?)*

Ss: *Yes*

After asking students to tell the perimeter of their houses, it appears that students still could not give the answer straight away. Then together with the metaphor of 'fence', the teacher relied on the local language to help his students to make sense of the 'perimeter'. The teacher assumed that the students are aware of the principle of recontextualisation when asking 'if the perimeter of the school is that fence which divides the school from the other side', then what is the perimeter of your house then? The school fence should be understood as a 'boundary'. Mr Kafula re-emphasised that 'if you cross it (the fence), then you are in somebody's place or territory'. This statement appears to have convinced some of the students that a mathematics perimeter means a fence indeed. A mathematics perimeter refers to something that surrounds the learner's house. As a result, to name the perimeter of their houses, students mentioned what their house fencing is made of or rather what surrounds their houses: sticks, walls, and buildings.

Surprised by student answers, Mr Kafula further asks: Is it when you are in the rural areas or in the urban areas? Some of the students would have referred to their house fencing in the villages while some might have referred to housing circumstances in the towns. Based on what students conceived a mathematics perimeter to be, students introduced other metaphors (e.g. sticks, walls) to signify the mathematics perimeter of their houses. The teacher's question raises the question of whether a perimeter in the rural area would differ from a perimeter in a town. In other words, the use of the 'house' metaphor creates the potential for ambiguity and multiple meanings. A house is a three-dimensional object, while its floor plan is a two-dimensional shape. Until this time, the teacher did not refer to dimensions; failing to do this might have raised some doubts in students' minds.

Further in the episode, Mr Kafula defined the perimeter as that which 'divides the plot (i.e. erf) from the neighbour's place'. From this, it appeared as if the teacher is making an attempt to give his students a sense of what a perimeter means. All signifiers recruited by the teacher and students are taken from their familiar environments. The invented signifiers of a perimeter introduced in the above episode are summarised in Table 4.

Table 4: Signifiers for the perimeter

A sign = signifier + signified	
Repertoire of signifiers	**Signified**
Distance around the shape	Perimeter
Distance around the object	
A line which forms a boundary	
Fence of the school (fence which divides the school from the other side)	
Sticks fencing (such as at a village house)	
A wall fencing (such as at a village house)	
That which divides the plot from the neighbour's place	

Based on this teacher-student interaction, one might argue that both teacher and students invent a repertoire of signifiers to denote mathematical concepts. Some of these signifiers came about as a result of guidance given to the students by the teacher.

From the interaction above, one could sense the demands and consequences of recruiting the everyday into the mathematics classroom. The teacher made use of whatever they deemed appropriate to communicate mathematical concepts. Often the possible consequences of what is recruited cannot be foreseen. It could also be submitted that at times during these interactions, what appears as legitimate criteria for answering the teacher's questions may not be obvious to the students. The subsection that follows demonstrates how the same lesson proceeded. It also shows how this process can cause misunderstanding or ambiguity of the non-arbitrary mathematical structure.

6.2.1 Code-switching as an option in bridging the academic and the everyday

Subsequently, it seemed that the teacher was not yet convinced that his students got the point he wanted to communicate. He resorted to storytelling and relied more on the local language.

Excerpt 4

T: *Nowadays oha tu udu ovanhu ta va ningi shike- ta vapula Omalenga, vati omhunu a kufa ko onhele ya mukwao, hasho? (Nowadays we hear people lodging complaints to the Headmen that somebody took my piece of land… isn't?)*

Ss: *Ee (yes)*

T: *Aaye mukwetu o wa ya kokule unene. E he na ngoo langhele oku. Ee? (You hear them saying my friend, you have gone too far, please reduce up to here.) That is the perimeter that divides the plot from the neighbour's place. Are we together?*

Ss: *Yes*

T: *That is why it is very important to know measurement and to know how to calculate the perimeter.*

Ss: *Perimeter*

In this episode, Mr Kafula resorted to storytelling in one of the local languages. The expression in this message (words or wording) and what the message is taken to refer to – its content (lodging complaints to the headmen) – are weakly institutionalised. This could be termed as a public domain text. Though the intention is not clear as to why Mr Kafula narrates this story, one hypothesis could be that the teacher wanted to draw learners' attention and for them to become engaged in the lesson. The second hypothesis could be that this is what the teacher construes as a way of making his students appreciate mathematics. The third hypothesis could be that the teacher might not have found appropriate terms in the English language to explain the mathematical term of a perimeter. On the other hand, Mr Kafula was perhaps trying to initiate his students into critical thinking about social issues. He was probably attempting to introduce students to how social conflicts such as illegal land appropriation could be addressed mathematically. This is still not that clear. This story was employed to explain the term perimeter. It has shown how arbitrary settings can be recontextualised (and at times transformed) to conform to the particular, non-arbitrary mathematical structures that are to be explained.

6.2.2 Creating a hybrid between pure mathematics and everyday discourse

Nine minutes later, Mr Kafula began to explain how a perimeter can be calculated with numbers. At this stage, it appeared that this was his first step in introducing his students to the esoteric domain of mathematics. However, Mr Kafula appeared to have remained in the public mode of action. The foregrounded story is weakly institutionalised (a domestic activity of allocating communal land). The word feet used here is a human foot, not the metric unit of feet. The teacher continued to rely on the local language while telling stories.

Excerpt 5

T: *But when it comes to the shapes, we use numbers. We use numbers. Traditionally we only use what? We only calculate the ((feet)), hasho? (isn't?).*

Kema: *Yes*

T: *Ha tu ti apa naapenya naakwinya… yah … onhele yoye oyo yo. Operimeter, omunhu ngeenge ta tendelwa epya laye. Ee?*

(We say from here and there and there and up to there. That is your place. The perimeter, is when somebody's piece of land is measured, isn't?).

Ss: *Ee*

T: *Ngaashi nee vamwe okwa li ha ku tiwa kutya- You know long time ago … yah from here … just decide where to end. Omunhu o to ha nge nee a kufa ko nee onhele ihapu ya kula.*

Like it is also happening to the what? I think this side of- Uukwambi. Hamutenyawa Ndahafa's place.

[*The teacher mixes local and English language]*

(Just like for some people … long ago … they used to say start from here, decide for yourself where to end. You would find that a person has taken a large piece of land.

Like it is also happening to the what- I think this side of Uukwambi area, at Hamutenya wa Ndahafa's place)

Ss: *Yes*

T: *A very big place. But now people are busy dividing it into farms again.*

Soini: *Ooh*

T: *Yes. Because they own- they take out the big place. O pena ovanhu vamwe ve li selfisha. O to kufa ko nee onhele i fike op ongahelipi? Oove auke? (Yes. Because they own- they* *take out the big place. Some people are selfish. How can they take such a big piece of land? Are you the only one?) What about others? How will they survive? (( )) You see. You must take what is enough for you.*

Some are just taking the big place, but they are not using it. O u na ashike omupya wa dja apa fiyo o kOmufiya kwinya, ile kOndagwa ngoo. Ove o u naeengobe di li nhano. (You just have a huge piece of land from Omufiya or even from Ondangwa and you have only five cows.)

Ss: *[Laughter]*

T: *Ee, noikomboi li omilomgo ne. I li omhilongombali ku tya. Ee? O to dulu ngoo okulonga po apeshe opo?*

(Yes, and 40 goats; I mean 20. Yes? Are you able to work on that huge piece of land?)

Tauno: *Ee (yes)*

T: *Yaah people … make sure that when you are taking a place of your own … leave for others please. Do not be selfish yee? To kufa ko ngoo she ku wana ove to fiilepo mukweni yee. Nande ota mu kongaakonga ngoo nande omapya komifiya kwii… oto kufa kongo oonhele yoye ye ku wana.*

(Yaah ... people … make sure that when you are taking a place of your own … leave for others please. Do not be selfish, ok? Just take what is enough for you and you leave some for others.

Even when you go to Omufiya to look for a piece of land, you have to take what is enough for you.)

Ss: *Ee (yes)*

T: *To kufako ngoo eemeta donhumba … to valula … you measure it and make sure that it is enough for you. Don't just take everything. (Just take a certain number of metres, count them … measure them and make sure that it is enough for you. Don't just take everything.)*

Mr Kafula continued to link his lesson to students' familiar experiences. Mr Kafula recontextualised a non-mathematics, traditional, and domestic activity of how people measure a piece of land. This is normally done by counting the number of human feet (a non-standardised unit of measurement). Mr Kafula inculcates in his students social responsibilities and perhaps developed a sense of solidarity among his learners. He taught his students not to become selfish people. To some extent, Mr Kafula went as far as creating a sense of humour for his students. Perhaps his students enjoyed the lesson through this teaching tactic. (Although he might not necessarily have helped them gain access to the esoteric mathematics). Notably, the teacher mentioned that ‘the perimeter is when somebody’s piece of land is measured’. However, when the headmen allocate a piece of land, they rely on context-based mechanisms and perimeter is not discussed. This again shows that what transpires in mathematics lessons is not always pure mathematics and nor is it normal everyday activities.

6.2.3 A teacher’s attempt to move towards the esoteric domain of mathematics

Eleven minutes later, Mr Kafula appeared to be in the early stages of introducing his grade 8 students to the esoteric domain of mathematics. However, there appears to be a hierarchy in the esoteric domain. This is because before Mr Kafula introduced strongly institutionalised terms such as rectangle or square triangle in his vocabulary, Mr Kafula introduced weakly institutionalised terminologies (e.g. adding, calculate). Terms such as add or calculate can be referred to as weakly institutionalised terms because these words are frequently and commonly used in non-mathematical settings, and a person does not need to have an in-depth understanding of mathematics to engage with all these terms. Following from these, one could say Mr Kafula seemed to have remained in the lowest level of the esoteric domain. Secondly, even though Mr Kafula mentioned the calculation of the perimeter, the whole episode only went as far as recalling the names of geometrical shapes learnt in previous lessons and no calculations been made so far. At some point, Mr Kafula made a shift and relied on the expressive domain terminologies he introduced earlier (T*: But remember as I said. The perimeter is a distance around the object.*) This is how the lesson proceeded:

Excerpt 6

T *(proceeds): Fine. What about the shape? How do we calculate the perimeter? People whenever we are calculating the perimeters then we have to add the sides. [pause] Ee? [pause] How do we calculate the perimeter? It is when we add the sides together. Very good. But remember as I said. The perimeter is a distance around the object.*

Ss: *Object*

T: *Therefore now we are going to look to- on how to calculate the perimeter of different shapes.*

Ok. I think you are done with this one?

Ss: *Yes*

T: *Ok copy now. ((pause)) This is what? Mmm? Be serious.*

Ss: *[laughter]*

T: *((pause)) Teacher writes notes on the chalkboard.*

Ss: *[Students whisper among themselves]*

T: *Can I clean this side?*

Ss: *Yes*

T: *Ok. Fine, any question before we start? Anything you do not understand? Any problem?*

Ss: *No*

T: *Any Malaria?*

Ss: *No*

T: *Ok. Fine. ((pause))*

Ss: *[Students whisper among themselves]*

T: *[teacher continues to write on the chalkboard]*

Ss: *[Students whisper among themselves talking about soccer tournament among various schools]*

T: *Ok. Very good. [Pause as teacher continues to write on the chalkboard] Ok. Fine people.*

We have to pay attention to the chalkboard. Pay attention. May I have your attention, please?

Ss: *Yes*

T: *Ok, we have four different shapes or three shapes on the chalkboard.*

Ss: *Yes*

T: *What is the name of the first one?*

Ss: *A triangle*

T: *A triangle. The second one?*

Sos: *Square … rectangle.*

T: *It is a square or a rectangle?*

Ss: *Rectangle*

T: *A rectangle. The third one?*

Ss: *Rhombus*

T: *Ee?*

Ss: *A rhombus*

T: *Rhombusa [sic]*

Ss: *[laughter]*

T: *It is a?*

Ss: *Parallelogram*

T: *It is not a rhombus, but it is a?*

Ss: *A parallelogram.*

T: *The fourth one?*

Ss: *Square*

T: *Square. Fine. Now we know the names of these shapes.*

In this episode, one could see his attempt to move towards the esoteric domain of mathematics. Twenty minutes later, Mr Kafula continued to operate in the esoteric domain. At some point, he continued to rely on the expressive domain text he introduced earlier. Mr Kafula drew some figures on the chalkboard and asked the students to work them out. The students should have done lessons on perimeter in previous grades; therefore, this would probably not be a major problem for them. The lesson proceeded with the teacher calculating the perimeter of geometrical shapes, and the teacher scored their work until the end of the lesson. The following excerpt shows how the lesson proceeded:

Excerpt 7

***T** (proceeds): Can we start calculating the perimeter of these shapes?*

***Ss:** Yes*

***T:** I said the perimeter is a distance around what?*

***Ss:** Shape*

***T:** Ok. Can you do that one for me now?*

***Simon:** Yes*

***T:** Hurry up … hurry up … hurry up. [pause] Time. The time is limited. Draw the shape then you calculate the perimeter. I will only give you maybe how many minutes before I start marking the first one?*

***Sos:** Five minutes … seven*

***T:** Ok. Five minutes. Seven ... ah that is too much.*

***Sem:** Eight*

***T:** Prove to me that you understand that statement. [pause] Aaaa. Individual work. Individual work. Individual work.*

Individual work. It is an individual work. You are done?

***Mark:** Yes*

***T:** [pauses as the teacher began to mark student's class work]*

This was how this lesson proceeded until the end. The notion of signifier and signified as well as the domain of actions mentioned above will be continued below. Above, the researcher used Mr Kafula's lesson not only to highlight what is meant by the notion of signifier and the signified but also to briefly highlight what transitions teachers may take as they incorporate the everyday in the mathematics classroom. The next section will demonstrate how the patterns of interaction in classrooms were determined.

6.3 Describing the structure of observed lessons

6.3.1 Structure of the lessons according to didactical function and time allocations

The researcher's way of describing the structure of the observed lessons drew heavily on the work of Jablonka (2004). However, due to the differences in the way the teachers present their lessons, there were some modifications. Modifications are employed either on naming didactical functions or on the naming of interactions. The first stage of analysing these lessons was grouped under four headings: Setting Stage; Reviewing; Sharing, Introducing or Developing New Knowledge; and Practising & Applying.

(i) Setting stage: Setting stage is a lesson component in which the teacher introduces the topic of the day and lays down procedures. It includes all physical directional instructions and all mathematical activities necessary for being able to start working on a task. The task might be a new one on which the students are supposed to work in order to develop a new procedure or explanation, or a task for practising in the lesson.

(*ii) Reviewing:* Reviewing consists of giving or correcting answers for previous work, such as giving feedback on homework. It also includes summarising and refreshing topics, as well as checking learners' background knowledge. The subject of discussion may be topics or concepts from previous lessons taught in both lower and higher grades.

(iii) Sharing, Introducing and/or Developing New Knowledge: The lesson components are categorised as sharing, introducing and/or developing new knowledge for a number of reasons. First, the teacher might be giving an outline of a new topic or introduce the theme or concept to the class. Usually, this is done as a way of leading students into the lesson. Secondly, the teacher might be telling or informing students about what is to be done on that day and giving examples of how it should be done. Overall, this component entails sharing, introducing new content to the majority of the students, or developing content that is not completely new to students. This may include giving definitions such as for terminologies or concepts, formulae, and procedures or solution methods.

(iv) Practising & Applying: Practising and applying components of a lesson is the section in which students are allowed, whether individually or as a group, to actively perform and engage with what they have learnt. It is a lesson component where the teacher gives tasks to his or her students based on what was taught. The lesson phase contains a task(s) which require students to implement what they have just learnt, although they might not yet have a thorough understanding. Such tasks may or may not be for scoring purposes. These sessions may have strict, little or no control by the teacher. Class work is one good example of these sessions. In summary, Practising & Applying is a lesson component in which students have to use concepts, definitions, terminology, formulae, procedures or solution methods (which are supposed to be shared knowledge of the class) and apply them in a new or familiar situation for the purpose of familiarisation or re-familiarisation (Jablonka, 2004).

6.3.2 Describing the lesson structure according to minutes per episode

Following the aforementioned description, the analysis of the observed lessons noted the number of minutes per episodes. The resulting information is shown in Table 5. The different colours represent different headings or didactical functions. Codes such as Mr Sakeus and

Mr Kafula represent the anonymised names of different teachers whose lessons were observed. Using Mr Sakeus' lesson as an example (see Table 5), his lesson was scheduled for 40 minutes, though completed in about 39 minutes. In this lesson, no stage setting was observed. His lesson began with revision, which lasted for six minutes. This section is then followed by the introduction or development of new knowledge, which lasted for about seven minutes. Finally, it was the practising and applying session which took longer than the other two sessions. This took about 26 minutes of the lesson. Table 5 shows how this analysis was carried out on seven lessons.

Table 5: Approximate minutes per didactical function

Set stage	Reviewing	Introducing / developing new knowledge	Practising & Applying

Mr Sakeus – Grd8 Mr Kafula – Grd8 Mr Nakamwe – Grd8 Ms Taleni – Grd7 Ms Helao – Grd7 Ms Dorkas – Grd5 Ms Olivia – Grd 5 HK = housekeeping

Mr Sakeus										
6	7	26	Tot: 39 min							
Mr Kafula										
2	2	3	3	2	9	2	3	7	2	Tot: 35 min
Ms Taleni										
1	40	Tot: 41 min								
Ms Helao										
7	3	3	6	7	2	2	4	Tot: 34 min		
Ms Dorkas										
HK	5	26	11	43 min						
Mr Nakamwe										
5	15	8	2	6	6	Tot: 42 min				
Ms Olivia										
2	2	1	7	3	4	3	21	43 min		

Although this table does not reveal much about teachers' ways of linking school mathematics and everyday life, preliminary deductions from the Table 5 suggest that there are differences in the way teachers approach their lessons. For example, there are teachers whose lessons start with a preparation stage (setting stage), while others begin with a revision. However, the lesson structure may well look very different for the same teacher on different occasions. More than half of the total lessons (four out of seven) appear to recruit the setting stage. It also appears from these patterns that although the setting stage takes place at the beginning, it can also take place towards the end of the lesson. From these patterns, one may note that a large proportion of the time allocated for the lesson is taken up by introducing and developing new knowledge followed by the practising and applying, and then the review. This is evident from Table 6.

Table 6: Approximate sum of minutes allocated per didactical function

Lesson code	Set stage	Reviewing	Sharing, Introducing & Developing New Knowledge	Practising & Applying	**Total**
Mr Sakeus	0	6	7	26	39
Mr Kafula	2	2 + 3 + 2 + 7 = **14**	2 + 3 + 9 + 3 + 2 = **19**	0	35
Ms Taleni	1	0	40	0	41
Ms Helao	2	7 + 3 + 4 = **14**	3 + 6 + 2 = **11**	7	34
Ms Dorkas	1	5	26	11	44
Mr Nakamwe	5 + 2 = 7	15	8 + 6 = **14**	6	42
Ms Olivia	0	2 + 1 = **3**	2 + 7 + 3 = **12**	3 + 4 + 21 = **28**	43

What appears to be common among these teachers, when looking at Table 6, is that they recruit review in their lessons. Some employ this strategy at the beginning of the lesson (e.g. lessons by Mr Sakeus, Ms Helao, Ms Olivia and Ms Dorkas), some in the middle of the lesson (e.g. lesson by Mr Nakamwe), some across the lesson (e.g. Mr Kafula and Ms Helao), while others may choose not to employ a review at all (e.g. Ms Taleni). Although some lessons appear to be dominated by the Sharing, Introducing & Developing New Knowledge section (Mr Kafula, Mr Taleni and Ms Dorkas), some teachers appear to prefer lessons dominated by the Practising & Applying section (Mr Sakeus and Ms Olivia).

The following analysis is intended to highlight how mathematics as an activity makes reference to other domains of practice or knowledge. The same set of lessons is analysed, and this discussion follows next.

6.4 Exemplars of interactional texts coded for different domains of actions

If the data is detached from the framing model, this could make it difficult to analyse what is going on. For this reason, it was decided to briefly reiterate the analytical framing that was used as a lens to interpret the data. As highlighted in Chapter 3, Dowling described school mathematics as an activity that exhibits a highly explicit grammar in terms of what may count as a mathematical utterance and what may count as a true mathematical utterance (Dowling, 1998, p. 2). Dowling (1998) used DAS scheme to elucidate this. The DAS scheme is divided into four domains or regions of practice: esoteric, public, expressive, and descriptive. These regions are differentiated according to the forms of expression (the signifiers or how the text is tuned up) and the content (what is being signified or referred to). The form of expression and content are measured separately in terms of strength of classification or the degree of institutionalisation, that is, how strong or weak it is (Dowling, 1998, pp. 132-135). Strongly institutionalised (I+) text denotes the text that deploys exclusively technical mathematical signs, while the weakly institutionalised (I-) text denotes text that deploys signs where the expression and content are arbitrary with respect to mathematics (Dowling, 2007). Notably, Dowling (2007) proposed that the access to the esoteric domain of an activity may not be fully realised within these three domains, particularly if they are recruited in isolation. This is one of the key reasons why Dowling argues that access to the esoteric domain is so crucial if the primary goal of mathematics is to develop mathematics knowledge. The lessons' texts were analysed according to the above-mentioned domains of actions.

First, an attempt was made to look at the subject of discussion as well as the 'discursive closure' (Dowling, 1998, p. 138). Discursive closure is a technique that helps the one analysing the text to determine where the subject of discussion starts and where it ends. This technique helped to divide the text into episodes of text. Secondly, episodes were further divided into topics and subtopics. More attention was paid to texts that appeared to make links (i.e. recruit 'the everyday' as resources for teaching mathematics). Finally, texts that appeared to have the characteristics of each of the four domains of actions were categorised (Dowling, 1998). The presence of public, expressive and descriptive domain texts, as well as their relations and transitions to the esoteric domain, are used to determine particular ways mathematics teachers incorporate the everyday into the mathematics classroom. Clearly, the esoteric domain is ultimately the domain into which teachers intend to apprentice students if the curriculum is an academic one. Hence, a teacher who only or predominantly engages the esoteric domain also reveals a view on the relation between the academic and the everyday.

Next, exemplars of such texts are presented as well as their preliminary analysis that led to the development of a table of domain patterns of teacher practices indicated in Table 7. These texts aid in understanding how such patterns were developed. First, what was coded as public domain texts will be presented. Below is an interaction text taken from Ms Olivia's grade 5 lessons.

6.4.1 Interactions coded as public domain texts

Excerpt 8

T: *Let me say that one day your mother sent you to Spar, ne. She needs a 1kg um packet or sack of sugar. She wants a 1kg sugar from Spar. But when you go in Spar, there were no 1kg. There was only the 500 gram … the 2kg … and the 2.5kg and the 5kg. But your mother needs 1kg. What will you do? Shetu*

Shetu: *We buy two of 500g.*

T: *We will buy two 500g. It is equal to how many kgs if you buy them two? If you buy two 500g? Why you cannot go back home and tell your mother that there is no 1kg? Why do you have to buy the two 500g? Juliet.*

Juliet: *Because when my mother sends me 1kg and I have to buy it. Then I saw the two 500g and I buy two packs and when I see the total is one gram.*

T: *One gram?*

Juliet: *One kilogram*

T: *One kilogram. That means 1000g – Because these one 500g times two gives me 1000g. Is equal to 1kg ne. Is that what you are trying to say?*

Ss: *Yes*

The talk constitutes a task which was classified as public domain text. The discussion that follows does not appear to divert from this domain. There are other reasons why this text was categorised as public domain text. First or all, the text or this talk recontextualises the economic or domestic practice of shopping, which is looked at from the perspective of mathematics. Secondly, its mode of expression or the tone used to communicate with students is weakly institutionalised. Its content, that is, what is being referred to, is a shopping activity, which is weakly classified. Thirdly, it is characterised by a vocabulary of signifiers, which are mathematical entities. These are, for example, two of 500g, one 500g times two gives 1000g, the total is one kilogram, just to mention a few. Fourthly, except the last part of the talk where the teacher said *"one 500g times two gives me 1000g",* if one sees or hears this discussion somewhere else, it might not immediately be recognised as mathematics. Here, it appeared as if the teacher was attempting to introduce his or her learners to addition, multiplication, as well as the conversion of standardised units of length and measure.

In light of mythologies constructed by school mathematical texts, the shopping context is recruited, and mathematics is constructed as a reservoir of use-values. In other words, mathematics is portrayed as if it is for shopping. The activity discussed in the narrative is about buying sugar of a certain quantity. The student is given names (you, sugar, mother, and some scripts (e.g. 500g, 2kg) on the chalkboard. Names, in this case, represent the character in the narrative, while scripts show the character of an item to be bought (sugar). These narratives describe the meaningful practice of shopping. Through these narratives, students might idealise their mothers sending them to the shop rather than imagining themselves as being people who own money and who are able to make calculated decisions.

Though there are some mathematical terms such as equal to, times, and scripts displayed on the chalkboard, much of this task appears to be so much about shopping than mathematics. For example, statements such as "your mother sent you to Spar" and "Why you cannot go back home and tell your mother that there is no 1kg?" are indicative of the ordinary domestic activity of shopping. However, towards the end, infiltration of mathematical terms and statements such as 'one 500g times two gives me 1000g' signals that this interaction seems to be organised according to priorities of mathematics rather than entirely following the contours of the non-mathematical activities of shopping. In this interaction, one can see that mathematics then is not so much being constructed as potentially about itself; rather, it is for something else. Mathematics is for shopping; it enables or facilitates shopping. This creates a myth of participation.

On the other hand, the shopping activity appears to be described in terms of the self-referential knowledge of mathematics. The myth of reference means that mathematics is presented as being capable of describing or modelling all other kinds of processes and systems and leads to a description of how these activities work. If this teacher's belief was that everything can be described in terms of the self-referential knowledge of mathematics and that mathematics can reveal the 'true' workings of the buying sugar activity, then this teacher has constructed a myth of reference. Since the teacher did not make reference to this at all, it could be inferred here that this teacher might have construed the utilitarian aspect of mathematics at the lowest level of a myth of participation.

An example of an interaction that was also characterised as public domain, but slightly different from the one displayed above will next be presented. In the next talk, although the text does not appear to be examined from the perspective of mathematics, there appears to be a move towards mathematisation. This is one of the lessons Mr Kafula presented to his grade 8 learners.

Excerpt 9

T: *(We are ready to do it.) Now pay attention, please. Do not worry … pay attention. Iyaaa. So … for example- Becky … how many metres or kilometres are from your home up to this school? Eee?*

Becky: *I think is-*

T: *Ee?*

Becky: *It is maybe one kilometre.*

T: *How do you know?*

Becky: *I am not sure because I did not measure it.*

T: *You did not measure it? Ok, thank you.*

Becky: *But just by estimating.*

T: *By estimating?*

Becky*: Yah.*

T: *Do you think it is very important to-to measure something?*

Ss: *Yes*

T: *Why?*

Becky: *It may be that someone- you want to direct a person to your house, but you don't know how to direct that person. By telling the person that there is how many kilometres to your house … so you have to tell them there is maybe two kilometres to the house, and you do not measure. That is why you have to measure it to find how many kilometres are there.*

T: *Ok. What about if you tell the person that- ah from here up to your house is only three houses? Is that fine?*

Ss: *Yes*

T: *Yes? Why?*

Ss: *Because-*

T: *Ee?*

Sekupe: *Because you just count the houses.*

T: *You just count the houses?*

The foregoing talk or text was categorised as another form of public domain. Unlike the aforementioned text, it does not appear to be looked at from the perspective of school mathematics, but there is a move towards mathematisation. Mathematisation refers to a process in which something is being rendered more mathematical than it was before (Jablonka & Gellert, 2007, p. 1). Two interpretations are deduced from this text and both point to the public domain of action. The teacher introduced the topic ‘measurement’ and narrowed down the theme through a question for a particular student about how far it is from school to her home, including units of measurement in the question. Mr Kafula asked Becky who says she did not measure the distance. The legitimate criterion is not evident at all. This question suggests that the legitimate answer would be an agreement about the importance of measurement. Could this be public domain? In Dowling’s scheme, ‘public domain’ means that the whole thing amounts to mathematisation. Asking questions by the teacher such as “how many kilometres from your home to school?” and “how do you know?” and the answer given by the student such as “It is maybe one kilometre” and “I am not sure because I did not measure it” can be taken as a sign that this conversation is moving towards mathematics. Alternatively, if someone asked “how many kilometres is it to your house?”, this person cannot be interpreted as doing mathematics simply because they wanted to know a distance. It can also be interpreted as a move towards getting more accurate directions, which does not necessarily equate to a move to more formal mathematics. In this text, the teacher attempts to link the mathematical measures to the distance Becky normally travels from her home to school. It could be that when Becky walks this distance, kilometre and metres never crosses her mind. For some people, such as student Sekupe, when walking similar distances, perhaps all they consider is counting the houses between.

The second interpretation is that the pedagogy that is employed here appears to be weakly framed (Bernstein, 2000). This is because the legitimate criterion is not evident and therefore students can answer this question in any way they see appropriate. This makes it look public domain because of the weak framing of criteria. Since there is only a small amount of apparently technical signifiers (km and m) and no other mathematics comes in, the researcher sees this as public domain text. Here, km and m are categorised as weakly classified or institutionalised signifiers because these terms are used on a regular basis in everyday talk. While they refer to numerical entities, they do have a point of reference outside the domain of mathematics. Still, when people use these terms in everyday conversations, one would not say that they are engaging with specialised mathematics.

It is not just other weakly classified conversations because the question “How do you know (Why do you say so? and I am not sure because I did not measure it)?” gives an impression that this is moving towards mathematics.

Furthermore, this talk was not only about the distance Becky walks between her home and school, but it was also about the importance of measurement. Though the second issue was about the importance of measurement and it does not bracket out mathematics measures and non-mathematics measures, Becky gave her answer based on mathematical measures (telling the person that there are so many kilometres to their house … and one does not measure). In contrast, the teacher explicitly draws on non-mathematical measures: “What about if you tell the person that … ah from here up to your house is only three houses?” and asks the students whether that is fine. One of the students acknowledges that this is another appropriate way of measuring distance. When the teacher asks why, Sekupe justified “Because you just count the houses”. The form of expression of this text is weakly classified. What is discussed here or what is being referred to is the importance of measurement (weak classification). This is public domain.

Compared to curricular texts (in mathematics textbooks and question papers), there appears to be a great deal going on in the classroom when the teacher makes links. As already stated, there are times when the teacher recruits other domains of activities that are looked at through the eyes of mathematics, and there are times when this is not the case but rather just an act of moving towards mathematisation. There also appears to be a third case. The third case seems to be circulated in the name of promoting the importance of school mathematics or its concepts. For example, Mr Kafula recruited other forms of public domain texts different from the two raised above. He recruited a story of what is happening between some tribes in Omangeti area.

Excerpt 10

T: *That is why people I say, it is always very … very important to do what-measurement. Like right now … eee … omapya kwinya ha ku limwa ota a vixwa… hasho? (Like now … farms where people cultivate are being measured … isn’t?) Didn’t you hear that story of what is happening in Omangeti area there? Eee? Between some tribes? Ndongas want to chase Kwanyamas from Ndonga area because they said they took so big places unnecessary.*

Iyaa … they want them either leave the place or divide it.

Mark: *Ho hoo*

T: *Yaah*

Mark: *[Laughter]*

T: *Yah because- Do you know where the problem is coming from?*

Ss: *No*

T: *Eee?*

Ss: *No*

T: *Do you know where the problem is coming from measurement?*

Ss: *No*

The context recruited in this excerpt is the national concern of tribal conflict. Similar to the other forms of public domains referred to already, the mode of expression of this text is weakly institutionalised. What is being referred to here is the tribal conflicts and the importance of mathematics. However, although the tribal conflict is recruited, it does not appear to be looked at through the eyes of mathematics as the shopping activity of 1kg sugar in *Excerpt* 8. Though a mathematics object of ‘perimeter’ was later drawn in the dialogue, the dialogue does not appear to explain the concept of perimeter originally. On the other hand, this is not a social science lesson, but the teacher appears to teach about social justice in a mathematic class. Although the teachers were teaching about social justice in a mathematic class, unlike with other researchers (Gutstein & Peterson, 2005), the teachers did not do so with numbers. Since the part of the lesson appears to explain the importance of measurement, which is a mathematical perspective, one could say this is another version of public domain. However, as there was no move towards the esoteric domain of school mathematics, it might as well be considered unrelated to any attempt of looking at the activity with a mathematical gaze.

6.4.2 Texts that were coded as pointing to public domain of something else

The two excerpts that follow are typical examples that appear not to be looked at from the perspective of mathematics, and there appears to be no move towards mathematisation. According to Dowling (1998), the public domain is the domain of recontextualisation where non-mathematical practices are recontextualised according to mathematics principles. In the following texts, there is no recontextualisation according to mathematical structures. For this reason, the following texts cannot be referred to as public domain texts (as in Dowling’s vocabulary). These texts represent something other than public domain. Perhaps one could call it other public domains or public domain of something else. Mr Kafula explained the necessity of learning how to read and take measurements in mathematics in the excerpt that follows.

Excerpt 11

T: *That's why even you need to know. If you know, it is not going to be difficult for you. Even if you go to South Africa … eee? You only look to the what- information boards. The one you find on the roads there.*
Saima: *Mm*
T: *Eee?*
Saima: *Mm*
T: *Just read in maps then you say ahaa … now from here to here is only these kilometres. Then now I have to go that side and make sure I have to come reach here before the sunset. Are we together? It is always good to take measurements.*

The dialogue above is about travelling outside the country (going to South Africa) and the importance of reading measurements marked on information boards. Again, this text is weakly classified in terms of content and expression. On the same note, this text does not appear to be looked at from the perspective of mathematics but only shows the benefits of taking measurements when travelling. To some extent, this also suggests a myth of participation. Mathematics is indeed portrayed as an operational tool to be utilised in other diverse activities. On the other hand, this discussion might have a fantasising purpose behind it. By fantasising, it might have been recruited for students to idealise travelling to South Africa one day. Alternatively, perhaps it was just to highlight the utilitarian aspect of mathematics without explicitly highlighting how students can use mathematics in this activity. This interactive session also appeared to fall under the public domain of action. Likewise, in explaining why people need to know measurements, Mr Kafula recruited the domestic activity of building traditional houses.

Excerpt 12

T *(proceeds): Even people when they are making their traditional houses … how they do it? Eee?*
Nekoto: *They use …*
T: *Before … they use what?*
Nekoto: *(Rope)*
T: *The other instrument is what? Traditionally is what? Feet.*
Tim: *Oo … yaah*
T: *Isn't?*
Tim: *Yah*
T: *They start drawing what?*
Tuyoleni: *Lines*
T: *Eee?*
Ss: *Lines*
T: *Lines using what? Then they call an elder person inside the hut and start drawing the house using feet.*

That is why people you suppose to know the measurement.

Recruiting the foregoing domestic activity of making traditional houses, it seems as if the teacher did not clearly articulate the difference between non-mathematical and mathematical measures. Possibly, the teacher holds a view that does not draw a distinction between mathematics activity and other domains of activity. The teacher might not be aware that there are standardised mathematics measures and non-mathematics (traditional) measures such as those which are carried out in the domestic activity of making traditional houses. The feet mentioned here do not refer to feet as in imperial units. Texts such as these are examples that were coded as other public domain texts that have no move towards mathematics. Next, a presentation of an example of interactional text that was coded as expressive domain texts, or expressive modes of pedagogic action, will be provided.

6.4.3 Interaction coded as expressive domain text

In another grade 5 lesson, Ms Taleni was teaching the topic of length and poses the following realistic problem or context to his learners:

Excerpt 13

T: *A shoemaker wants to cut a piece of string which is 22.5 metres long to make a shoelaces that are 42 centimetres long. Ok. The question comes. A … How … many … shoelaces … can be cut … from the … piece of … string? Ok.*

T *(proceeds): Let's start from here. People first of all- because you can see that you have different units here, heh- you have different units. This one is 22.5 metres … while this one is 42 centimetres. You can see that you have two completely different units. So … what are you going to do? You have to convert … ne.*

You have to do some conversion here so that you so that you can have the same unit- because you cannot mix up chicken and goats … hasho (isn't)? That is why you have to convert so that you will have the same unit … ok.

This aforementioned task provides minimum information about the setting and simply encoded a mathematical structure in a familiar language, which is shoelace cutting. The excerpt began with the task or problem that might be categorised as falling under the public domain. This is because it is weakly classified in terms of expression and content. What is recontextualised is the non-mathematical activity of shoemaking, and the vocabulary of signifiers appears to be less specialised (metres and centimetres).

However, to explain to the students that metres and centimetres are different units of measure which cannot be added together, the teacher has to rely on the other domain, which is the expressive domain. The teacher shifted from public domain to the expressive domain. This might be due to the fact that the context became more mathematical than before. The activity is no more about cutting shoelaces only (an activity that can even be carried out at home without using mathematical procedures). This is now a mathematics activity that requires the conversion of units. This is worth mentioning because the task does not clearly specify whether this is a professional or domestic activity of shoemaking.

To engage his students in this activity of conversion, the teacher needed to rely on something else outside mathematics. The teacher probably wanted his or her students to understand the need to convert, as well as the rationale behind the conversion of units. While explaining the two different units of measuring length in the task, the teacher relied on the expressive domain. The teacher introduced two metaphors to denote mathematics objects. The teacher used names of animals to represent two different units of measuring length. Chickens represent metres and goats represent centimetres or vice versa. Mathematical objects are described in terms of non-mathematical signifiers. Since a non-mathematical form of expression is embedded within a mathematical context, this was coded as an expressive domain.

The recruited chicken and goat terms are now being mathematised. In real life, chicken and goats are not kept together, and perhaps there is no point or sense in mixing them up. The two embedded non-mathematical forms of expression (chicken and goats) indicates that the two terms are recruited to facilitate the explanation of the two different units (i.e. metres and centimetres), and this suggests that this text belongs to the expressive domain text.

In terms of mathematics as a mythologising activity, the discussion recontextualised a domestic or economic activity of shoelace cutting. Mathematics here is portrayed as a necessity in an attempt to understand this affair of society (shoelace cutting). The task context could possibly communicate to students that failure to recognise the mathematical component in this shoelace cutting activity means one is not capable, smart or intelligent enough.

In another lesson, Ms Helao, a grade 7 teacher, was teaching her students conversion between fractions, decimals, and percentages. At some point, the teacher needed to explain the concept of equivalence between a fraction, a decimal, and a percentage. Similar to the teacher just mentioned, the teacher had to rely on something else outside mathematics. This time, the teacher used an iconic mode of signification (a poster) (Dowling, 1998). In the poster, there is a picture of a 500ml can of Cola and the text written in different languages (i.e. English and Oshiwambo). English is the official language, and Oshiwambo is a local language. The Oshiwambo language has seven different dialects. The teacher used two dialects from Oshiwambo language (i.e. Oshindonga and Oshikwanyama) to translate what is written in English to Oshiwambo. The text in English, which is the medium of instruction, reads: This is my house. The text in Oshindonga reads: Ndjika egumbo lyandje. The sentence in Oshikwanyama reads: Eli eumbo lange. That would make a total of three languages. The following excerpt shows what happened during the lesson:

Excerpt 14

T: *Now … yesterday we also said that um common fraction … percentages and decimal fractions they are like different numbers … alright. But they mean-- they mean the same thing … is it not so? That is why yesterday we also gave you this example here.*

Ss: *Yes*

T: *That all these are in different languages, but they are only talking of the same thing. Alright. Also here … you have … we also have to say today that a half a litre … fifty per cent of a litre and zero comma five a litre they are all referring to this. Alright ... is it not so?*

Ss: *Yes*

T: *We say per cent means?*

Ss: *Out of a hundred*

This text deploys technical mathematical signs such as ½, 0.5 and 50%. In its vocabulary of signifiers, there are strongly institutionalised mathematical terminologies such as common fractions and decimals. Also, the topic that was being taught is conversion between fractions, decimals, and percentages. Having these in mind, one could say the context here is mathematical.

Once again, non-mathematical forms of expressions are embedded within a mathematical context. These non-mathematical forms of expressions are used to explain, or refer to, mathematics relations. For example, when Ms Helao used three sentences in three languages, she used them to signify the concept of equivalence. The idea could be to show that just as one has the same meaning in different languages, one can have different representations in mathematics that point to the same thing. The motive behind different language was explained by the same teacher in post-lesson interviews. When asked to give an example to pick out from her lesson that she thought bridged mathematics and the everyday, Ms Helao explained:

> *Alright, I am going to give an example because that is how I see it, but I think I will speak under correction because I'm not really sure if it's linking or not. For example, we were dealing with converting common fraction to decimal fraction to percentage, but this, what I did is I tried to make the learner understand that common fraction, decimal and percentage is like different languages, you know. But, when they talk for example like half a litre, 0.5 litres, and 50%, they are actually just saying about one thing, but they are saying it in a different way. So I somehow give them an example of different language whereby they are saying like this is my house, but they are speaking it in different languages, but they mean one thing. So somehow I try to … I'm not sure if I'm linking but I just try for the learner to understand when we say we can convert common fraction, percentage, and decimal by referring to the language so that they have an understanding that if someone say for example a half of a population or 50% of a population, they actually refer to the same thing. But they are just saying it in a different way, either you are saying it now in common fraction or percentage or decimal fraction. I think that I would say somehow I link it with the knowledge they know, that of the language with the knowledge of the mathematics.*

This was how Ms Helao managed to bridge mathematics and the everyday, although she acknowledged that she was also not sure whether what she did could be constituted as bridging mathematics and the everyday, and whether that is one of the better ways of doing it. Once again, in this interactional text, the mathematical objects were described in terms of a non-mathematical signifier. Since its mode of expression is weakly institutionalised, and what is referred to (mathematical equivalence between decimals, fractions, and percentages) is strongly institutionalised, the text is coded as an expressive domain. Next, an excerpt which is an example of what was coded as descriptive domain text will be discussed.

6.4.4 Interactions coded as descriptive domain texts

In one of her lessons, Ms Taleni presented the task below to her grade 5 students. The number of kilometres an athlete runs per day as part of his training is given in the task. Students were to determine the number of metres an athlete ran in a day. To do this, students were to convert kilometres to the nearest metres.

Excerpt 15

T: *Ok. Um … this one is supposed to be a class work … but we are just going to do it in class, ne. Ok. It says- number one says: An athlete runs 5.83 kilometres per day as part of a training programme. A … Calculate the distance to the nearest metre in 12 days. Ok. And B … Convert your answer in A into millimetres.*

Ok. What are we going to do?

Ss: *[Silence]*

T: *You said you are done with this side, ne?*

Ss: *Yes*

T: *Ok. Listen carefully. Aam … the word problem is saying that the athlete runs 5.83 kilometres per day, ne … everyday. This athlete runs 5.83 kilometres … ok. Then … can you calculate or can you find the distance to the nearest metres in 12 days? How many metres this person is going to run in 12 days? Ok. What we are going to do first is- we are going to convert kilometres into metres so that we can find out how many metres does this person runs in one day, ne. Ok. Five point eight three kilometres what?*

Ss: *Into metres*

T: *Into metres. Ok.*

T *(proceeds): Then you must find the relationship between kilometre and metres ok. But before that, let me ask you. Between kilometre and metre … which unit is big and which unit is small? Kapena.*

Kapena: *Metre is the smallest*

T: *Meter is the smallest. Kilometre?*

Kapena: *Is the biggest*

T: *Ok. Then … if you are converting from big to small … are we going to multiply or divide? Kaimbi.*

Kaimbi: *Multiply.*

T: *Multiply. It means you are going to multiply 5.83 with?*

Kaimbi: *One hundred*

T: *What is the relationship between kilometre and metre? Ben.*

Ben: *One thousand*

T: *It is one thousand. Ok. Let's move our decimal point. How many zeroes do we have here?*

Ss: *Three*

T: *They are three- which means we are only going to move our decimal point forward three times. One … two … three.*

And what will be the answer? It will be? Kalimbo.

Kalimbo: *Five thousand eight hundred and thirty*

T: *Mmh. Five thousand eight hundred and thirty. Mmh … what? … Donkeys, ne? Aune.*

Aune: *Metres*

T: *Metres. Ok. You now know that this person or this athlete can now run five thousand eight hundred and thirty metres in a day*.

First of all, the text in the task appears to constitute three domains in it. To make this point clear, the text is separated into several parts and are discussed separately. The text on the first part of the task is "An athlete runs 5.8 kilometres per day as part of a training programme". This text appears to be public domain text. The reason is that the form of expression (make-up or the way that first part is structured) and what is referred to are weakly institutionalised. For example, if one sees this sentence somewhere else, one would not immediately recognise it as mathematics. That is why this is public domain.

Secondly, the teacher then moves into the descriptive domain in letter A. A non-mathematical leisure context of a training athlete is recontextualised and is described in mathematical terms. Additionally, the test introduces technical school mathematical terminology in its expression. For example, the text 'calculate the distance to the nearest metre' is technical mathematics vocabulary, and what is being referred to is something non-mathematical, namely, the total distance run by this athlete. Still, the last sentence in the excerpt (i.e. T: Metres. Ok. You now know that this person or this athlete can now run 5830 metres in a day.) confirms that the athlete's activity of running was indeed described in mathematical terms. Since a non-mathematical context or activity is described in mathematical terms, part (a) of the task is therefore descriptive domain. Alternatively, this task appears to be a hybrid, as it has a mathematical and non-mathematical dimension. The mathematical dimension is the concepts of conversion and proportionality, while the non-mathematical dimension is the running activity of an athlete. It is also worth mentioning that although that part of the task was descriptive, the interaction that followed drew on or relied on other domains such as the expressive domain. When the teacher wanted to remind her students to put the unit, he asked them whether they were to put donkeys. Donkeys is a metaphor used to signify mathematics units of metres in this case.

The third part of the task, that is, question B, signals a move into the esoteric domain of school mathematics. This is because it uses mathematical forms of expression and does not refer to anything outside of school mathematics. Esoteric domain texts are discussed next.

6.4.5 Interactions coded as esoteric domain texts

First, it is worth noting that most of what is transcribed and coded is what is uttered during classroom interaction. However, most of what constitutes explicit esoteric domain text is written either on the chalkboard, textbook, worksheet, handouts, or displayed on the poster. Below are some of those examples.

A: Mathematical text on the chalkboard

B: Mathematical text on the handout

C: Mathematical text on the poster

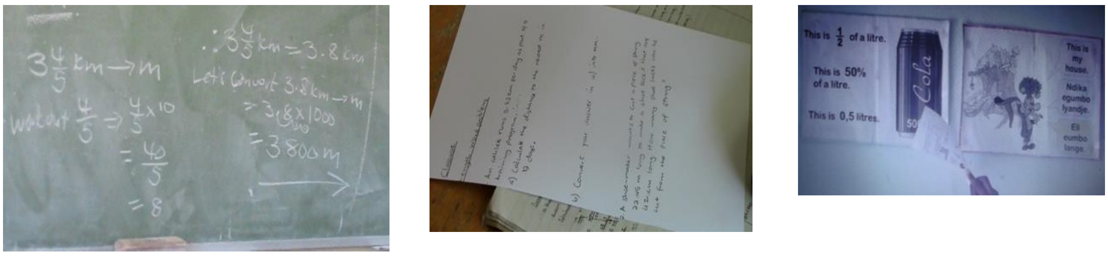


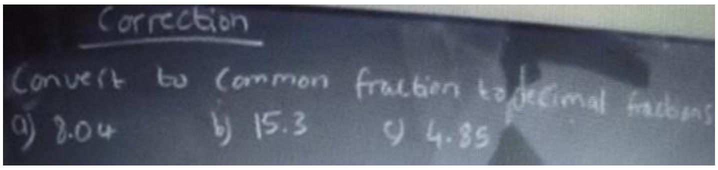
Figure 7: Mathematical texts on different teaching and learning aids

Three examplars of texts that were coded as an esoteric domain will be presented. The reason why three examplars are given is because the researcher needs to show that esoteric domain texts manifested in three forms during classroom interaction. Dowling (1998) gave an example where the text coded as esoteric domain was unambiguously mathematical text. Among his examples was: Solve for **x.** 0.2x + 4 = 16. Though most of the texts that take this format are on the chalkboard, textbook, worksheets, and handouts, it is argued that along with what is on the chalkboard or worksheet, some texts that are uttered during teacher-learner interaction can be regarded as falling under esoteric domain. During classroom interaction, such utterances manifest in two different forms.

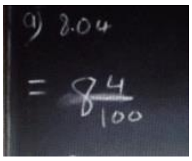
(i) As a revision text

This is as a part of the lesson where the teacher is sharing new knowledge and demonstrates to the students how to solve a maths problem. Such text might come about during oral testing. By oral testing, reference is being made to a stage where a teacher asks his or her students to name or list some aspect of school mathematics content. Usually, students' answers to the teacher's question are basically recalled information or knowledge. An examplar of such texts will be presented below. The lesson below was given to the grade 8 students. Mr Sakeus began the lesson by revising and giving feedback on the previously given homework.

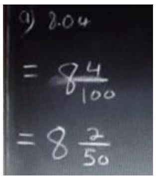
Excerpt 16



T: *Our homework was about converting common fractions to?*
Ss: *Decimal fractions*
T: *Decimal fractions.* Alright*. For example, here you have 8.04. So … to convert this to decimal fraction, you just look at the numbers after the decimal point. How many numbers after the decimal point do we have here?*
S: *Two*
T: *So the denominator should be? Or over what?*
S: *Over hundred*
T: *The denominator should be?*
S: *Over hundred*



T: *Over a 100 because there are two numbers after the decimal. So we write our denominator here. And because we have one number on the left side of the decimal point that is going to be our whole number. And then we have 4 over 100. So this number- I mean this fraction is not yet simplified. So we can take a number that can divide into numerator without a reminder as well as into the denominator.*
So what number can we take that can divide both the numerator and the denominator without a reminder?
Ss: *Two*
T: *Two. So we write our whole number here then we say 2 in 100 it goes how many times?*
Ss: *Fifty*



***T:** Fifty times. And in 4?*

***Ss:** Two*

***T:** Two times. So this number can still be simplified, isn't?*

***Ss:** Yes*

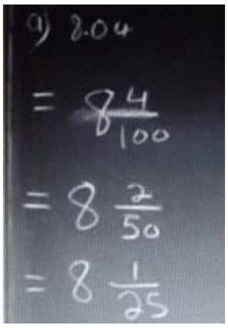
***T:** We write our 8 here as a whole number, then we say which number can we take?*

***Ss:** Two*

***T:** So we can say 50 divided by 2 is equal to?*

***Ss:** Twenty-five*

***T:** Two divided by two*



S: One

***T:** So in this way, it is now simplified.*

Even if one were to read the above text without looking at the inserted pictures, one would immediately recognise this as a mathematical text. The text above uses mathematical forms of expression and does not refer to anything outside school mathematics. It contains specialised, abstract mathematical terms or statements, which might be elaborated either as a set of relational principles (e.g. simplifying and the concept of equivalence between two or more fractions), or as a set of procedures (instrumental). The text involves mathematical inscriptions of decimals, fractions, and an equal sign (=). The word 'simplify' is clearly to be interpreted as a mathematical process and not for the process displaying a new simplified tax system or to simplify the story for the younger audience. This text exhibits a strong institutionalisation of specialised mathematics knowledge. Though the level of specialisation of mathematical text or content is relative in terms of the grade and perhaps student age, one would conclude here that since the mode of expression, as well as the content, is strongly institutionalised, this is indeed an esoteric text. A text which is an examplar of a lesson will be present next.

(ii) Presentation of new knowledge

In this lesson, Ms Helao shared new knowledge and demonstrated to the students how to solve a mathematics problem.

Excerpt 17

T: *Before I come to that one, I just want to explain the other method on how you can convert a common fraction to percentage. The other method … I can write a half. And then ask yourself … which number I used to multiply with two to give a hundred. So which number in this case? It is going to be?*

Ss: *Fifty*

T: *So multiply everything with?*

Ss: *Fifty*

T: *One times 50, then you get?*

Ss: *Fifty*

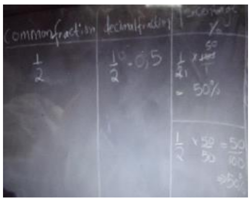
T: *And then 2 times 50, you will get?*

Ss: *A 100*

T: *And you know that anything out of a 100 is?*

Ss: *Per cent*

T: *Fifty per cent. So these are the two methods. The other method you just multiply with a hundred*.



Dowling (2007) noted that in any practice, if there is a pattern of how things are done and that everybody can recognise, then one could say there is some degree of institutionalisation. "For example, in the case of school mathematics, one can easily distinguish between text that deploys exclusively technical mathematical signs and the text that deploy signs where the expression and content are arbitrary with respect to mathematics" (Dowling, 2007, p. 5). The text or utterance above is unambiguously mathematical, as they deploy exclusively technical mathematical signs and vocabulary. Secondly, it makes no reference outside the mathematics domain. This text was also categorised as the esoteric domain text. The text in the excerpt below taken from one of the other lessons of Mr Kafula is of the same nature.

Excerpt 18

T *(proceeds): Ok. Fine. What are the units now … units? The smallest unit in measurement is what?*

Sem: *Millimetre*

T: *Eee?*

Ss: *Millimetre*

T: *Millimetres*

Ss: *Centimetres*

T: *Centimetres. The other one?*

Setson: *Metres*

T: *Metres. The other one?*

Setson: *Kilometres*

T: *Kilometres. The other one?*
Sem: *No*
Maria: *The tonnes*
T: *What?*
Sos: *No … tonnes*
T: *For the lengtha? Tonnes for the lengtha? [sic]*
Sem: *No*
T: *Aaye … be serious. Eee?*
Soini: *Hectares*

The preceding talk is about the units of measuring length. Similar to the esoteric texts just displayed, nothing is recontextualised, and the text does not refer to anything beyond its own domain. Furthermore, the units of length (e.g. mm, cm, and m) are all units of measurement, but they are not intra-mathematics concepts. That is, the notion of a kilometre or a hectare has an external point of reference in real-world practice, and in many ways these concepts only make sense when related to or contextualised in terms of the real world. For example, how would a teacher explain what 1km is to someone without referring to real-world practice? A teacher could use the argument that 1km = 1000m, 1m = 1000cm, 1cm = 10mm, but this might not lead to an understanding of what 1km is as a measured distance of a real-world phenomenon. Representation in Table 7 is a result of the analysis such as the one displayed in the above categories of texts.

6.5 Domain patterns of teacher practices

Table 7 presents seven lessons by seven different teachers. Mr Sakeus, Mr Kafula and Mr Nakamwe are grade 8 teachers; Ms Taleni and Ms Helao are grade 7 teachers; while Ms Dorkas and Ms Olivia are grade 5 teachers. These lessons were given at these grades respectively. The lessons were analysed by categorising episodes of texts in the same manner described above (see Section 6.4). Among the seven lessons that will be displayed shortly are six lessons in which various interactions appear to bridge mathematics and the everyday. One lesson whose text seemed not to display any bridging is also presented (e.g. Mr Sakeus' lesson is one that appeared not to bridge mathematics and the everyday).

In addition, some inscriptions are inserted in the non-coloured cells of the table to show modalities of interactions that were taking place at certain stages of the lesson. A description of Table 7 and the inserted inscriptions are discussed next in Section 6.5.1.

Table 7: Domain patterns of teacher practices of making links within an episode of text

Esoteric	Public	Other Public + move 2 maths	Expressive	Descriptive	Other public & no move/ public of something else	Copying (**Sc**), Housekeeping (**Hk**), Welcoming remarks (**Wr**), Settling down (**Sd**)

Lesson codes	Episodes, themes and subthemes within episodes							
	1	2	3	4	5	6	7	8
Mr Sakeus								
Mr Kafula								
Ms Taleni		Sc		Sc				
Ms Helao		Hk						
Ms Dorkas	Wr							Sc
Mr Nakamwe	Sd		HK		Sc			
Ms Olivia					Sc	Sc		

Continuation 1:

Teachers	Episodes, themes and subthemes within episodes							
	9	10	11	12	13	14	15	16
Mr Sakeus								
Mr Kafula								
Ms Taleni								
Ms Helao								

Continuation 2:

Teachers	Episodes, themes and subthemes within episodes							
	17	18	19	20	21	22	23	24
Mr Sakeus								
Mr Kafula	Dead mock reality					Sc		

6.5.1 The structure and descriptors of Table 7

Table 7 was set up according to the subject of discussion and 'discursive closure' (Dowling, 1998, p. 138). These two techniques aided in dividing the lessons into episodes of text. Episodes were further divided into topics and subtopics. Texts which appeared to bridge mathematics and the everyday, and texts which appeared not to refer to anything outside mathematics were identified and categorised according to the domain of actions. Texts which appeared to have the characteristics of each of the four domains were coded. Since the purpose was to see how mathematics makes reference outside itself, more attention was paid to the three modes of recontextualisation: the public, expressive and descriptive domains (Dowling, 1998). The representation shown in Table 7 is the result of this analysis.

Table 7 consists of seven different lessons by different teachers of various grades. The four main colours (purple, green, yellow and blue) are used to represent the four Dowling domains of practice. Purple represents the text coded as falling under the esoteric domain. Yellow signifies the expressive domain text, blue denotes the descriptive domain text, and green designates the public domain text. The green colour has three different sections (dark green, medium green and the light green). The dark green represents a public domain text where there is a sign of recontextualisation, and the recontextualised practices or activities are viewed from the perspective of school mathematics. The other two diluted green colours are what the researcher referred to as other versions of public domain. The medium green represents the type of public domain text which does not seem to be looked at from the perspective of mathematics but signals a move towards school mathematics. The light green is used as the code for the text that appears not to display the move towards mathematics. These sorts of texts may have perhaps been used as a means to promote the importance of mathematics, as well as to promote its utilitarian aspects.

The lessons were divided into episodes of text. These episodes are not necessarily of the same length. Some of the episodes were further divided into small cells which represent the subthemes discussed within each episode. In other words, each episode represents the subject of discussion, whereas individual cells represent subtopics or subthemes. Like episodes, different colours in those cells represent different domains of practices that were recruited as the utterance of that particular text. These cells should not be interpreted as representing one minute as appearing in Jablonka (2004). Although some lessons have fewer episodes, the time period for all lessons was 40 minutes. The other descriptors are (**Sc**), which shows the section of the lesson where students were given time to copy from the chalkboard. (**Hk**) stands for Housekeeping, where either the teacher or students were involved in distributing teaching or learning aids such as books, worksheets or handouts. (**Wr**) stands for Welcoming remarks. This is the section where the teacher introduces the researcher to his or her students. There are times when the students entered the class and it took some time before the lesson started. A time like this is usually filled with noise as students talk among themselves and that means there is no way a teacher can start teaching. Even if the teacher tries, it will be to no avail, as no one hears clearly due to noise. This part of the lesson is denoted by Settling down (**Sd**).

6.5.2 Deductions from Table 7

While making deductions from the table, attention was paid to three recontextualisation pedagogic modes (public, expressive and descriptive). This was because these are the regions in which mathematics makes reference outside itself. From this table, it appears that the least used domain was the descriptive domain. It is used only once by one teacher (see lesson by Ms Taleni). If this is the case with all lessons presented by six teachers, it can be asserted that modelling of school mathematics may not be taking place during the lesson presentations. This is because the descriptive domain is the region in which non-mathematics activities or practices are recontextualised and described in mathematical terms. As Dowling (1998, pp. 126-127) put it, the gaze may recontextualise a non-specialised setting, the contents of which are described in terms of mathematical forms of expression. This domain or practice is referred to as the descriptive domain. Usually, the specialised expression is being imposed on the non-specialised content from the position of the esoteric domain. Hence, the descriptive domain entails the arena of activity that recruits mathematical structures to ‘model’ non-mathematical texts and contexts.

Across all the episodes, public domain appears to dominate over other domains. However, since the time for each domain in relation to the whole lesson time is not yet determined (see Section 6.6.3), it is premature to decide that this is the case. In other words, the frequency of the coloured cells of each domain (e.g. esoteric, expressive) cannot be used as a measure of the overall dominant domain. This is because a specific colour might dominate, but the amount of time taken per specific episode is less as compared to others. However, the count relates to episodes as thematic units, independent of their length, and so may reveal a preference.

Still, the fact that some teachers might preferably use some of the domains may not only be dependent on the teachers’ choice but also be co-determined by the type of lesson or topic taught. Ms Helao, for example, used only two domains, and Mr Sakeus used only one domain. One could also deduce that there appear to be some teachers who used some domains more often than others, but still, this can be misleading with respect to pedagogic intention. Hence, more work needs to be done in addition to the representation in the table to establish whether this is the case. The example here is Mr Kafula. Dowling (1988) associated the myth of participation with the public domain of action. If it is the case that the public domain dominated some of these lessons, then this could also mean that these teachers' lessons are dominated by the myth of participation.

Judging from the patterns, it also shows that Mr Kafula recruited 'forms of everyday' (Sethole, 2007, pp. 68-69) that are in a way different from the other forms of everyday that other teachers have used. These are forms of everyday that eventually appear not to have been looked at from the perspective of mathematics. This will further be discussed below.

In addition, Mr Sakeus operated entirely in the esoteric domain, while Mr Nakamwe opted to operate in both esoteric and public domains. Though Mr Sakeus did not appear to recruit the everyday (in the form of everyday terms, contexts or settings), somehow he introduced rules of how to proceed. While introducing rules on how to proceed, Mr Sakeus said to his learners:

> *So now the trick is here. You look at the numbers after the comma. You count them. So you have one and two, isn't? So … one … two. That means that our answer here when you multiply this decimal fractions the answer will also have two numbers after the comma.*

As an alternative to bridging mathematics and the everyday, Mr Sakeus may have opted to use these procedures in his teaching instead. These rules might have helped students to get around the problem.

6.6 Shortcomings in using the DAS scheme as an analytic approach to bridging mathematics and the everyday

Although there are some advantages in using the Table 7 as the source of interpretation, there are shortcomings, particularly if the DAS scheme is used as the only source of interpreting teacher approaches to bridging mathematics and the everyday in a classroom. The reason is that the representation in the table only gives the picture of what domains were employed and which teacher operated in what domain. It also gives an overview of the frequency, as in how often each domain or mode of action was recruited. Nonetheless, it does not reveal anything about what actually transpires when teachers operate in those pedagogic domains. It also does not make known why teachers opt to use and rely heavily on one domain of action than others. Based on this reason, further analysis that penetrates deeper into the domains was necessary.

Attempts were made to look at the data further. The first attempt was to display the patterns of individual teachers' practices. This was done to determine whether there were similarities or differences among patterns (trajectories) that emerged as teachers recruit these three pedagogic modes. The second attempt paid attention to what happens during teacher-learner interactions as teachers incorporate the everyday in their mathematics lessons. The subsection that follows indicates how the first analysis was done as well as the findings.

6.6.1 Determining similarities or differences among individual patterns

Table 7 which shows domain patterns of teacher practices of making links was used. The same lessons were also used in this analysis. Red numbers are used to label sections within episodes. Picking Mr Sakeus as an example, episode 1 has four subthemes, and all their texts were labelled esoteric. Hence, the red number label is 1-4. The second episode of text had three subthemes; thus, the labelling continued from 5-7 (e.g. 5, 6, and 7). The sections are topics or subtopics that were discussed within that episode of text. How this was done is depicted in Table 8.

Table 8: Coding of sections, subsections and their domains of practice within an episode of text

Eso-teric	Public	Other Public & move 2 maths	Expressi-ve	De-scriptive	Other public & no move	Copying (**Sc**), Housekeeping (**Hk**), Welcoming remarks (**Wr**), Settling down (**Sd**)

Teacher/ Lesson code	Episodes, themes, and subthemes within episodes 1	2	3	4	5	6	7	8
Mr Sakeus	1-4	5-7	8-10					
Mr Kafula	1	2, 3	4	5	6	7	8, 9, 10, 11, 12	13
Ms Taleni	1, 2-3	4-5, Sc	6, 7-8, 9, 10-11	Sc 12, 13				
Ms Helao	1	Hk	2	3	4	5	6	7
Ms Dorkas	Wr	1, 2	3-5	6-7	8-9	10-11, 12	13, 14	15, 16, Sc 17
Mr Nakamwe	Sd	1	Hk, 2-3	4-11	12			
Ms Olivia	1-2	3	4, 5-6	7-10	Sc, 11-12	13-17, Sc		

This coding produced representations of individual teacher patterns of switching domains.

Continuation 1 of *Table 8*

Teachers/ Lesson codes	Episodes & themes within episodes							
	9	*10*	*11*	*12*	*13*	*14*	*15*	*16*
Mr Sakeus								
Mr Kafula	**14**	**15**	**16** **17**	**18** **19**	**20**	**21** **22**	**23**	**24-26** **27**
Ms Taleni								
Ms Helao	**8**	**9**	**10** **11-12**	**13** **14** **15** **16**	**17-18**	**19**		

Continuation 2 of *Table 8*

Teachers/ Lesson codes	Episodes & themes within episodes							
	17	*18*	*19*	*20*	*21*	*22*	*23*	*24*
Mr Sakeus								
Mr Kafula	Dead mock reality **28**	**29-31** **32**	**33**	**34**	**35**	**36-37** Sc **38**	**39**	**40**

Figures 8 and 9 display domain patterns of individual teachers, which have emerged as they recruit different domains of practice.

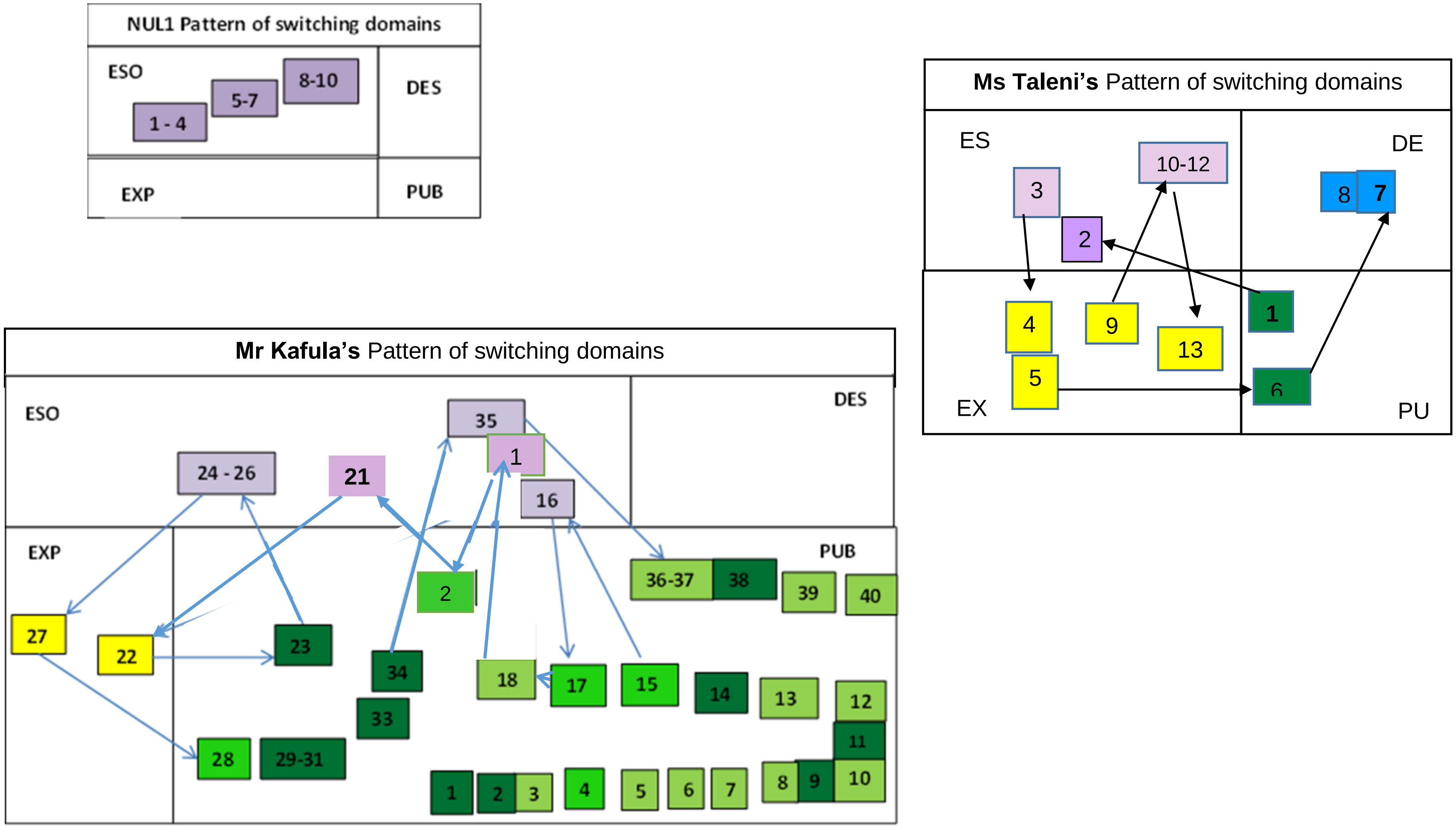


Figure 8: Individual patterns of how Mr Sakeus, Mr Kafula and Ms Taleni switched between domains of actions

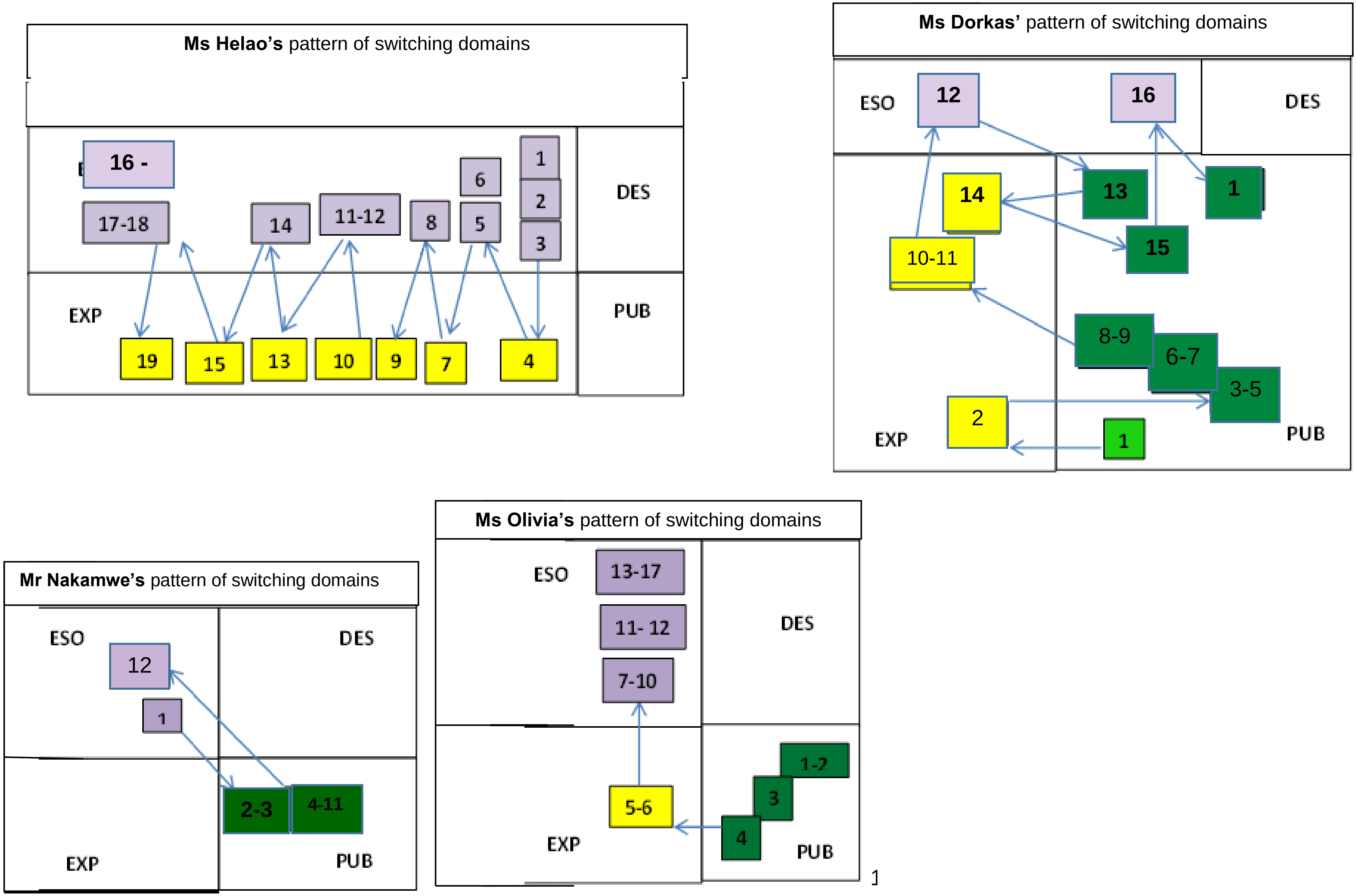


Figure 9: Individual patterns of how Ms Helao, Ms Dorkas, Mr Nakamwe and Ms Olivia switched between domains of actions

6.6.2 Deductions from Figures 8 and 9

As distinct from *Tables 7* and *8,* in *Figures 8* and *9,* one can see clearly how teachers switched between Dowling's domains of practice. From the foregoing figures, one can see individual teacher's trajectories and their approaches to incorporating the everyday. Figures 8 and 9 highlight whether a single domain of practice was employed and whether the teacher alternated between two or more domains. Moreover, one could also see that teachers may choose to operate within a single domain (as in Mr Sakeus' lesson), between two domains (as in Mr Nakamwe's and Ms Helao's lessons), between three domains (as in Ms Olivia's, Ms Dorkas' and Mr Kafula's lessons), or in all four domains (as in Ms Taleni's lesson). Furthermore, the figures highlight that teacher patterns of switching between domains might take a zigzag format (see Ms Helao's lesson). The zigzag happened between two domains (i.e. esoteric and expressive, in this case). In terms of direction of movement, the trajectory that is formed by the teacher patterns of switching domains could take a clockwise or anticlockwise format.

Apart from these descriptions, the crucial question one could ask is: Do these patterns support insights as to why the teachers chose these trajectories, and how do these patterns represent a specific way of thinking about the relationship between mathematics and the everyday? Key aspects of Dowling's DAS scheme are (i) the notion of apprenticeship into mathematics, (ii) the importance of a particular form of movement, and (iii) the engagement with the different domains. The presence of public domain in their teaching activities makes it clear that this is a pedagogic activity with students intended to be apprenticed to mathematical activities in which they are not yet knowledgeable. More importantly, these patterns could also possibly show more or less successful ways in which learners are eventually apprenticed into mathematics via these domains. From the tables, it can be seen that out of seven teachers, only one teacher guided his students using the descriptive domain. In other words, judging from these seven lessons, it appears as if teachers hardly engage or move via the descriptive domain. Hence, it looks as if teachers rarely engage modelling of 'real-life problems' as a route into mathematics. It is not possible to infer from the patterns reasons why teachers chose to follow these patterns or trajectories. Although the DAS scheme is a language used to describe teachers' trajectories and recruitment of the everyday, the teachers might not be reflectively aware of this. If teachers were made aware of these different possibilities and their (dis)advantages, follow-up interviews with individual teachers could reveal more about why they choose to follow certain trajectories.

While it is not possible to infer teachers' views about mathematics from these patterns, the trajectories suggest something about their views regarding the relationship between mathematics and context in pedagogic action. For instance, since almost every teacher recruited the everyday in his or her lesson, this could be a sign that a number of teachers see incorporating the everyday into the mathematics classroom as indispensable. Although it appears as if most of Mr Kafula's and Ms Dorkas' lesson was dominated by the public domain, it is premature to draw conclusions as to where this leads. A measure of the time taken per domain may reveal a more comprehensive image about what form of school mathematics students experience. This analysis will follow in the next subsection.

6.6.3 Analysis of time per domain

The next step of analysis looked at the time spent within each domain. For each teacher, the time taken per domain is recorded. Total 1 in Table 9 indicates the total sums of minutes and seconds per domain (as added from episodes), while Total 2 gives the total sum in minutes and seconds. Information about how the table was created is attached in Appendix 12.

Table 9: Record of time per domain

	Time per Domain											
	Esoteric		Expressive		Descriptive		Public		Public of something else & Move		Public of something else & no Move	
Teachers	**min**	sec	**min**	sec	**min**	sec	**min**	sec	**min**	sec	**min**	sec
Sakeus	39											
Kafula	5	40	1	1			6	56	7	17	15	7
Taleni	16	1	9	23	4	40	9	9				
Helao	21	14	8	45								
Dorkas	9	57	8	31			24	1				
Nakamwe	20	53					13	29				
Olivia	32	48	3	58			5	20				
Total 1	**142**	**213**	**29**	**158**	**4**	**40**	**59**	**115**	**7**	**17**	**15**	**7**
Total 2	**145**	33	**31**	38	**4**	40	**60**	55	**7**	17	**15**	7

From Table 9, one can see that the public domain (6 minutes and 56 seconds) dominated Mr Kafula's teaching as compared to the esoteric (5 minutes and 40 seconds) and the expressive domain, which took only about 1 minute. It is easily visible from the table that among the seven lessons, Mr Kafula is the only teacher who introduced other forms of public domain. It can also be seen from the table that the esoteric domain overrides other domains in the lesson presentations of teachers Taleni, Helao, Dorkas, Nakamwe, and Olivia. One question one could ask is whether students in these classes are learning mathematics that allows access to the esoteric domain principles as well as meaning-making via the provision of analogies from public domain activities that transform into structures that can be used for modelling (descriptive domain), or metaphorical meanings by employing expressive domain. Looking at Total 2, one can see that the esoteric domain dominated the observed lessons, and this is followed by the public domain. This appears to reveal that learners in these classes are apprenticed into the esoteric domain, but only without distinguishing between particular forms of esoteric domain activities, which may include more or less reasoning with principles. The specific question investigated in this study, however, is about the trajectories teachers seem to take in leading students to the esoteric domain through various forms of incorporating the everyday. It appears that the most emphasised route is the public-expressive-esoteric or public-esoteric rather than the public-descriptive-esoteric route.

6.6.4 Limitation of the representation of trajectories

Though the analysis just discussed brought about the distinction between individual patterns of switching domains, some aspects of the representations in *Table 8* and *Table 9* are ambiguous. For example, because both episodes and their subsections are labelled in the same way (red numbers in Table 8; black numbers in Figures 8 and 9), this makes it difficult to draw the difference between an episode of texts that was divided into subtopics and the ones that were not divided into subtopics, for example, in *Table 8* the number 6 in Ms Helao and the number 7 in Ms Dorkas. Though it is clear from this table that number 7 does not represent the whole episode as is the case with number 6, the depiction of the same cells with blocks in *Figure 9* blurred such difference.

In the foregoing discussion, an attempt was made to display teachers' patterns of engagement and trajectories. The next section will focus on at what happens during teacher-learner interactions as teachers attempt to incorporate the everyday in their mathematics lessons. The discussion will begin with the new forms of public and expressive domain which appear to have emerged.

6.7 Parallel pedagogic modes to Dowling's domains of practice

6.7.1 Other forms of public domain

In Section 6.4.1, when texts were analysed according to their degree of institutionalisation, what emerged was that there appear to be several forms of public domain texts. To avoid repetition, exemplars of these types of texts are displayed in *Excepts 9, 10 and 12*. In analysing curriculum texts, Dowling (1998) introduced a public domain text as a text in which other contexts or settings are recruited, mathematatised and subjected to the principles of school mathematics. Similar to Dowling's public domain category is the following:

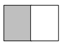
Excerpt 19

> ***T:*** *A farmer sells three cows with masses of 980 grams, 562 grams, and 42 kilograms. The question will be: Calculate the total mass of three cows*.

The text in *Excerpt 19* is weakly institutionalised in terms of its expression and content. Here the mathematics gaze is cast on farming as well as on the economic activity of selling cows. An economic activity of selling cows is recruited and looked at through the eyes of mathematics. Other public domain texts differ from this format of text. What the researcher perceives as other public domain texts does not appear to be looked at from the perspective of mathematics, but they signal a move towards mathematics. The text in *Excerpt 9* is an example of such texts. What differentiates the text in *Excerpt 19* from the text in *Excerpt 9* is that the text in *Excerpt 9* has no calculation involved, and the legitimate criterion is usually blurred. Besides these two public domain texts, there seem to be other forms of public domain texts. These texts are not looked at from the perspective of mathematics, and they do not signal a move towards mathematics. Instead, they appear to be recruited in mathematics lessons with the purpose of engaging or motivating students, and not necessarily to assist them to gain access to the esoteric domain of mathematics. The example of this is in *Excerpt 10* and *Except 12.* This subsection provided a brief discussion on what appears to be other forms of public domain. Other forms of expressive domain text will be discussed in the next subsection.

6.7.2 Forms of expressive domain

Dowling (1998) also identified texts classified as expressive domain texts. These are texts in which mathematical contents are described in terms of non-mathematical contexts or signifiers. One distinctive feature of this domain is that a non-mathematical form of expression is normally embedded within a mathematical context, and this signifier denotes mathematical objects. Another feature is that the text's level of institutionalisation has to be weak in terms of expression and strong in terms of its content. The observed data on classroom interaction appears to have revealed other forms of expressive domain.

A common example of expressive domain text might be one in which blocks or cells are used to represent a fraction. For example, the figure  could be taken as half a cake, representing a mathematical object of ½. Other forms of expressive domain can be identified in texts that refer to the introduction of rules or procedures. For example, in *Excerpt 20* Ms Dorkas taught rounding off to her grade 5 students, where she introduced some rules to help them proceed.

Excerpt 20

T: *Ok. Um if we are rounding off um we have rules to follow. We have rules to follow. And whenever we are talking of these rules, we have numbers that we use … from zero up to nine. Ok. And … we have these numbers … we have certain numbers that if you see them um that cannot be-- that can be rounded down or up-. Like for instance … this arrow … red. When you see colour red you see- What do you see? Mm? If now we are talking of-- We have this arrow … like- it can be? Can it be like … a go … a stop … or down or something?*

Ss: *Go*

T: *Go. At least we can look at these arrows when we are using them like- [silence] This green arrow … if you see any number that I am going to place on the chalkboard and it has a green colour, it means we are going to round?*

Ss: *Up*

T: *Up. And if you see the number that is on the red card, it means we are going to round?*

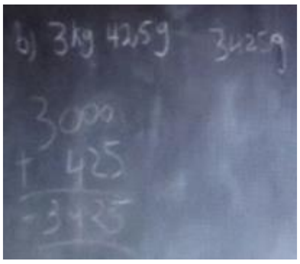
Ss: *Down*

T: *Very good. We are going to round down.*

In this excerpt, the teacher embedded non-mathematical signifiers which are arrows of different colours. A green arrow was used to denote an action of rounding up and a red one was used as a rounding down action. Considering the embedded non-mathematical signifiers, this text could also be categorised as another form of expressive domain. Considering the grade level at which this lesson was taught, one could ask: To what extent can the colours help students gain access to the esoteric domain of mathematics? To what extent does it allow students to get a sense of what rounding in mathematics means and why it is necessary to study this topic in mathematics? Obviously, the presence of coloured arrows is more like a traffic light that signals when a pedestrian is to cross the road and when to yield to cars. This might not add anything to students' mathematics knowledge.

A separate incident occurred when Ms Olivia taught her grade 5 students how to add numbers. Ms Olivia introduced this procedure to her students:

Excerpt 21



T: *Then now … all you are going to do … You are only going to change this 3kg. Then you say 3 times 1000. We write the three and three zeroes for a thousand.*

Then to the 3000, we add 425. You have to make sure that our numbers are in their place value, ne – according to their place values. From there, we add zero plus five is 5. Zero plus two is two. Zero plus four is four, and then we drop three down. The answer is 3425. That is the answer; it is correct.

This talk started with the esoteric domain. One would say it is esoteric domain because the talk recruited mathematical forms of expression and vocabulary. Later, Ms Olivia relied on the expressive domain to refer to a place value of 3000. Though Ms Olivia reminded her students to make sure that their numbers are in their place values, she could not explain to her students that there are zero thousands in the thousands place of digit 425g. Instead, the teacher used a 'drop three down' metaphor (metaphor as in falling or bringing something down) to refer to the place value of number three. The metaphor was used as a way to help students get around the problem. Another case that could be taken as a form of expressive domain is the one that recruits everyday terms such as names and uses them as substitutes for mathematical objects. For example, in her a grade 7 lesson in *Excerpt 13,* teacher Ms Taleni used names of animals to stand for different units of measuring length:

> *You can see that you have two completely different units ... You have to do some conversion here so that you, so that you can have the same unit … because you cannot mix up chicken and goats… hasho (isn't)?*

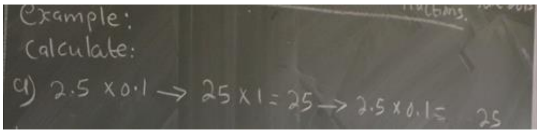
Ms Taleni relied on the expressive domain to remind her students to always put units in their answers.

6.7.3 Peculiar cases of signification

Analysis of texts also brought about ambiguous cases. It appears as if not only non-mathematical signifiers are used to signify mathematical entities but mathematical signifiers might also be used to refer to other mathematical objects that are however unrelated to the mathematical concept or procedure in question. In the following excerpt, Mr Sakeus was teaching grade 8 students how to multiply a decimal number by another decimal number. Mr Sakeus introduced a procedure which he called a trick:

Excerpt 22

T: *Today, we are going to do multiplying of quantities by a decimal fraction. For example … um 2.5 times 0.1.*



The trick is here. You look at the numbers after the comma. You count them. So you have one and two, isn't? So one … two. That means that our answer here when you multiply this decimal fractions- the answer will also have two numbers after the comma.

Once again, the teacher operated in the esoteric domain because the teacher's talk employed mathematical forms of expression and did not refer to anything outside school mathematics. However, to show the students the number of decimals that is expected in the answer, the teacher relied on something that is similar or parallel to the expressive domain. The teacher told the students to count the number of digits after the comma in each decimal fraction and add them together. In doing this, the teacher informed the students that the answers they got signify the number of decimal numbers in the final answer. In this case, there was one digit after the comma in both 2.5 and 0.1. Therefore, 1+1 = 2. This means that there were supposed to be two digits in the final answers. Students are to take 25 and write it as 0.25 (note the two digits after the decimal point). In this case, counting numbers after the decimal and adding them together is a mathematical activity, and this process was used to determine what the number of decimals in the final answer would be. Here, one could argue that the signifier (which is a mathematics activity) was used to refer to unrelated mathematical objects.

On a different occasion, Mr Sakeus used a similar approach or procedure to teach his grade 8 students how to convert a decimal number to a mixed fraction. This exemplar is depicted in the excerpt below.

Excerpt 23

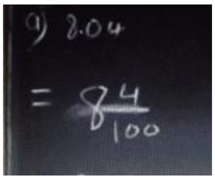
T: *Alright. For example, here you have 8.04. So to convert this to decimal fraction, you just look at the numbers after the decimal point. How many numbers after the decimal point do we have here?*

Salmon: *Two*

T: *So the denominator should be? Or over what?*

Salmon: *Over 100*

T: *Over a hundred because there are two numbers after the decimal. So we write our denominator here.*



And … because we have one number on the left side of the decimal point, that is going to be our whole number. And then we have 4 over 100.

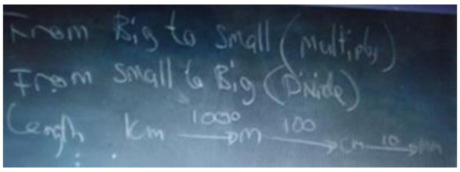
Once again in this instance, the number of digits after the decimal (referring to 0 and 4 in 8.04) is used to denote the number of zeroes in the fraction’s denominator. Similar to the cases above, instances like these have the possibility of helping learners to pass exams rather than helping learners to appreciate mathematics.

6.8 Making links, pedagogic metaphors and use of multilateral significations

The idea of the signifier and the signified in Dowling’s DAS scheme concerns ways in which mathematical meanings are communicated to others through various significations. It will be pointed out how the researcher observed teachers using a number of significations to denote the same mathematics object. The fact that the use of signification by teachers might be two-fold will also be pointed out. A sign can be unilateral (that is, only one signifier to denote a mathematical entity), but it can also point to two ideas at the same time. It emerged from the data that more signifiers may be used to signify the same mathematical entity. This is highlighted with the three inserted excerpts which have been selected because of similarities in terms of content and presentation.

Excerpt 24

T: *Now what we are going to look to is the Area. But before that one, we said for example in the case of the length- from kilometres to metres … what is the distance or the difference between kilometres and metres?*



Sheehama: *One thousand*

T: *Between metres and centimetres?*

Ss: *One hundred*

T: *One hundred. Very good. Between centimetres and millimetres?*

Ss: *Ten*

T: *Ten. Very good*

After asking his students to name the kinds of instruments people use when they do measurement, Mr Kafula, a grade 8 teacher, used the same procedures he introduced in the previous lesson. Mr Kafula asked: ‘whenever we are converting the unit from big to small … how do we do it?” The students responded just as they were taught previously: ‘We multiply’. Without justification, the teacher emphasised the importance of knowing the procedures. Mr Kafula then announced that the next subject of discussion is Area, but before that, they needed to recap on the concept of Length. Discussing length beforehand was a prerequisite for introducing the concept of area to his students.

To enable him to teach the concept of area, Mr Kafula had to recap the concept of length first. In addition, it appears that Mr Kafula had to rely on the expressive domain. Mr Kafula asked his students to mention ‘the distance or the difference’ between kilometres and metres. To explain this distance or difference between kilometres and metres, Mr Kafula relied on another mode of signification (iconic signification) (Dowling, 1998) by drawing on the chalkboard:

Km $\longrightarrow$ M

When students expressed that the distance or ‘difference’ between kilometres and metres is 1000, Mr Kafula added the named inscription to the drawing. Eventually, the distance or difference between a metre and a kilometre became the magnitude or unit size of a length measure. The explanation resulted in the expression that follows.

$$\text{Km} \xrightarrow{1000} \text{M} \xrightarrow{100} \text{Cm} \xrightarrow{10} \text{Mm}$$

Both the terms ‘distance’ between kilometres and metres, and ‘difference’ between kilometres and metres became 1000, which eventually signified equivalence between a kilometre and 1000 metres. This means that the terms distance and difference are not used here as distance and difference from a mathematics point of view (in mathematics context) – these terms are used from the everyday point of view. The two terms are everyday terms rather than mathematical terms. In other words, the term distance is not used to refer to the amount of space between two places as in Ondangwa and Oshakati, or to refer to the length measure between two fixed points A and B as in mathematics context. They were used to mean 1000. A thousand (1000) signifies the equivalence of 1000m to 1km. Similarly, the term ‘difference’ is not used to refer to an improvement in a situation (as in the amount of rain in this year as compared to last year) or to refer to subtraction as in mathematics context (e.g. the difference between 5 and 3 would be 2) – ‘difference’ here refers to the distinction between magnitudes of metre and kilometre. Alternatively, it refers to a certain amount of metres as compared to a kilometre (e.g. 1000m are equivalent to 1km). The terms ‘distance’ and ‘difference’ eventually became 1000, and suddenly 1000m equals 1km. As to the possible complexity of engaging context in relation to mathematical contents, this shows that signifiers that have precise meaning in mathematics suddenly take on multiple and possibly ambiguous meanings.

In a different lesson, Ms Taleni taught the same concept of unit conversions to her grade 7 learners and did something similar. Ms Taleni introduced another form of signification (i.e. interval) to denote the same concept.

> ***T** (proceeds): Then again … you must know the relationship between the two units. The relationship between centimetres and metres. Then this … aam … Shikwa found out that there is a difference or there is an interval of 100. That is why we multiplied 22.45 with 100, ok.*

Likewise, the talk introduced pedagogic metaphors ‘difference’ and ‘interval’ for unit conversions. Once again, these signifiers are used to explain mathematical objects or relationships. Equally, the two signifiers ‘difference’ and ‘interval’ are non-mathematical forms of expressions embedded within a mathematical context. These two signifiers ‘difference’ and ‘interval’ do not signify a maths concept of subtraction as the two terms seem to suggest. Equally, the term interval does not denote ‘the space between centimetres and metres’ because km and metres are not fixed points as in the interval between 1 and 2. Though both terms denote a ‘mathematical relationship’ between two different units of length measure, the term ‘difference’ also denotes variation or dissimilarity between the two units of length measure, and ‘interval’ designates their difference in magnitudes. Based on this point, it may also be argued that the use of signs in making links might be two-fold. One refers to non-mathematical denotation (e.g. variation between kilometres and metres, or metres and centimetres) and the other refers to their magnitudes. The implication here is that this could lead to potential confusion on the part of the learners in terms of how they interpret the signifiers.

Similar to the first teacher, the content represents strong classification, while the expression exhibits weak classification. Since these everyday terms which are non-mathematical elements are embedded in a mathematical context to help explain mathematical entities, this could be termed as the expressive domain.

To what extent does this pedagogic mode based on the expressive domain aid a student to make the connection between the concepts of distance, 1000m equals 1km or $\frac{1}{1000}Km = M$? How can this lead to the development of this mathematics relationship? Since km and m are not fixed points or places spaced from each other, as in the definition given by the teacher, somehow this could lead to ambiguity. It might not help the student to deduce the desired meaning. Perhaps further research need to look into alternative ways the same topic can be presented. Ideas discussed are summarised in Figure 10.

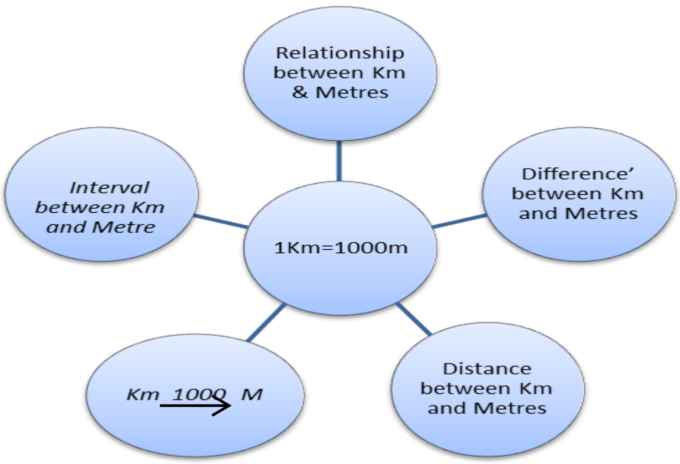


Figure 10: Multifaceted significations of the equivalence between 1000m and 1km

The next focus is on how Mr Kafula introduced another pedagogic metaphor and used the concept of *length* as a preface to introduce the concept of area. Mr Kafula proceeded with the lesson by defining the mathematical concept of area as a space.

Excerpt 25

***T** (proceeds): A length can be just a straight- for example, a distance between two points straight. Are we together? Like from here to Ondangwa … from here to Oshakati … from here to Ongwediva … and from here to your class … and from here to the toilet. Hasho? (Isn't?) For those who like going to the toilet.*

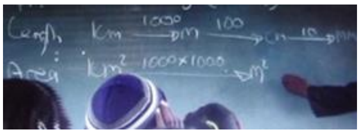
***Ss:** [Laughter]*

***T:** Ok. Fine. So now people- when we talk about the area, then we talk about a certain space. A certain space. [Teacher demonstrates by waving his hand in the air.] That is why we use a square and the units are squared. So it means now that for the area … kilometre square- it means now that you are also going to double this one. You are going to double this- multiply this one or repeating itself twice. ((Teacher points to 1000)). Very good.*

***T** (proceeds): Think about three to the power two. This means what?*

Is it three times two or is it three times three? Which is the correct one? Those who are saying three times three, rise up your hand. Ok. Those who are saying three times two, rise up your hand. Those who are neutral rise up your hand … because you don't know where you are.

Aa a aa ah. Be serious. Ee? People this means we have something repeating itself. Just like in a letter … P to the power two. It does not mean P times two. I mean P times two. No. This means P repeating itself twice. Therefore this one is wrong. This means three repeating itself twice. That is why people when we come to the measurement here, this is what we call- a square. But a square is a name given to the shape with equal sides. Therefore, now in the case of the units, it means now that the distance from kilometres to metre square – we are now going to double it. Hasho (isn't)? It means now 1000 times 1000. Can you see now? They must be two. And again … from metres to *centimetres square, now we have what? One hundred times?*



***Ss:** One hundred*

In everyday life, the term space can mean a number of things. Three possible meanings students might have in mind will be listed. First, space could mean an empty area which is available to be used. Secondly, space can be used to refer to that which is around everything that exists and which is continuous in all directions. Thirdly, space could mean a land especially in town which has no buildings. To enable him to explain the concept of length to his students, Mr Kafula used a second signification. Mr Kafula used his hand movement, to demonstrate the meaning of the mathematical concept of area, hence relying on the symbolic mode of signification (Dowling, 1998). By using his hand, it seems that the mathematics of the concept of area takes the second meaning of the word space – 'that which is around everything that exists and which is continuous in all directions'. Since the teacher is already in possession of the criteria and masters the mathematics content, this explanation could make sense to him alone, but to an apprentice, it might lead to confusion.

Mr Kafula proceeded to introduce the concept 'square'. Earlier on, he communicated that area is a space. His definition of the concept of area above implied that the area is space – that which is around everything that exists and which is continuous in all directions. With this explanation, he justified 'that is why we use a square and the units are squared'. This explanation could lead to ambiguity.

However, Mr Kafula's explanation did not leave students without consolation. The relief comes from the use of the representation already indicated. In the accompanying figure, the representation seems to clearly display how the concept of a square developed from the concept of length but Mr Kafula's explanation appeared not to be clear-cut on this matter. Mr Kafula pointed to 1000 on his drawing and justified that because the distance between km and m is 1000, 'it means now that for the area … kilometre square – it means now that you are also going to double this one'. Still, if one doubles 1000, one will get 2000 and not 1 000 000 as Mr Kafula is suggesting. The teacher did not go this far to clarify the point.

Mr Kafula then introduced another non-mathematical element 'to repeat itself'. He said: 'You are going to double this … multiply this one or repeat itself twice'. Similarly, if one walks 1000m and repeat this twice, they will have walked 3000m in the end. In this instance, the teacher used the term ‘double’ to refer to the squaring of a number. Likewise, Mr Kafula used the phrase ‘repeat itself’ to signify a mathematical square. Once more, this is another form of expressive domain. Mr Kafula might have done his best to teach and explain to his students what a mathematical square is, but the reason why students have to multiply a thousand by another thousand might still not make sense to a novice. That transition or trajectory from the concept of length to the mathematical concept of area might still be unclear for the student. The use of the term space as explained by the teacher might not even aid the student in establishing the connection between the mathematical meaning of the concept of area and the symbolic expression of $p^2 = p \times p$. The term ‘distance’, body language and the figure itself were used as springboards for aiding students in understanding and developing procedures for dealing with these concepts mathematically.

From the foregoing discussion, one could see that the expressive domain alone might not assist students much with regard to the development of the concept of area; this is particularly the case when the practice remains in the expressive domain. If, however, this domain is used as a springboard to the esoteric through provision of metaphors, then it could make for an effective strategy. That might depend, of course, on how the concept was introduced in the public domain or the nature of the representation that accompanies it.

Another example from the grade 7 lessons will be presented. In the following instance, Ms Taleni taught her students how to convert metres to millimetres. The teacher began by asking her students to compare which is bigger between a metre and a millimetre. Unlike before when Ms Taleni used the terms ‘difference’ and ‘interval’ between a centimetre and a metre, Ms Taleni introduced another term – *‘walking’*. The teacher asked ‘if we are walking from the big unit to a small unit, are we going to multiply or divide?’ That is, Ms Taleni used the term ‘walking’ from a metre to a millimetre as if unit measures of length were physical objects. Once again, the everyday term ‘walking’ is embedded to assist in explaining the difference between units of mathematical measures – a metre and a millimetre. This is obviously another form of expressive domain. The similarity between Mr Kafula and Ms Taleni is that both seem to objectify units of mathematical measures using different everyday terms. Again, to explain the magnitude between a millimetre and a metre, the teacher used the word ‘relationship’. In the corresponding excerpt, Ms Taleni asked ‘What is the relationship between metre and millimetre?’ and the student replied that it is 1000. To enable him to explain that there are 1000 millimetres in a metre, Ms Taleni used the term ‘relationship’. Once again, this appears to be an expressive domain strategy. By using a number of terms (e.g. space, doubling, repeat itself, relationship, walking) in making links, it appears that teachers have a repertoire of everyday terms that they use in facilitating this process.

6.9 Versions of expressive domains and student possibilities of relating with and benefiting from this domain's strategies

What remains to be discussed are ways in which students might relate with and benefit from expressive domain strategies. What could be the possibilities and impossibilities? Answers to this question were sought by drawing on the two excerpts presented next. The first excerpt is from Ms Taleni, a grade 7 teacher, while the excerpt that follows it will be taken from Ms Olivia, who is a grade 5 teacher. Although these teachers taught their lessons at different grade levels, these grades are both from Upper Primary. The other similarity is that both teachers employed what the researcher terms expressive domain strategies. The purpose is not to point a finger or judge whether this is good teaching or not. The intention was to examine the possibility of the expressive domain strategy to assist students in developing mathematical concepts such as the mathematical measure of lengths, area, and their units. As the data suggests here, the opportunity to do so appears to be small.

Ms Taleni's approach to recruiting 'the everyday'

The next excerpts are employed for two reasons. First, is to demonstrate how Ms Taleni's reliance on expressive domain strategies could assist her learners to interpret and understand the mathematical concept of 'conversions of units of measure'. Secondly, it is to demonstrate what the researcher termed as sub-categories or different forms of the expressive domain. *Excerpt 26* is meant to demonstrate how Ms Taleni recruits everyday terms to facilitate her learners' understanding of mathematical concepts. A metaphor of 'walking from big to small' is used to signify the use of multiplication.

Excerpt 26

T: *Ok. Now … let me ask you one question. Between metre and millimetres, which one is small and which one is big? Katali.*

Katali: *A metre is bigger than the millimetre.*

T: *Mh. Metre is bigger and millimetre is small. Now the second question. If today … we are converting um from metre to millimetre … are we now going to multiply or divide?*

Mm? Um … Secilia.

Secilia: *Divide*

T: *We are going to divide. If we are walking from the big unit to a small unit, are we going to multiply or divide? Kashali.*

Kashali: *We are going to multiply.*

T: *We are going to multiply. People … always, ne … if you are converting from a big unit to a small unit … ne … big to small … you are multiplying. From small to big, you are dividing.*

Aina: *Dividing*

T: *I think it is not only Aina who did that. But when I move around, some of you did the same.*

Ms Taleni started the lesson with mnemonics. A mnemonic is defined here as a special word that is used to help a student remember something. Mnemonics come in different forms, and the common ones are those in capital letters such as the BEDMAS for dealing with four basic operations. What the researcher refers to as a mnemonic here is different from the type of mnemonic shown above. For example, the words big and small might help students remember that a kilometre distance is longer (bigger) than a metre. Similarly, walking from big to small and vice versa might help them to remember the transition from one unit of measure to another. The introduction of these words (big, small, and walking) can be referred to as mnemonics. Ms Taleni relied on the expressive domain and asks: 'If we are walking from the big unit to a small unit, are we going to multiply or divide?' Walking from the big unit to a small unit is used to suggest the use of multiplication sign, while walking from the small unit to a bigger unit of measure suggests the use of a division sign.

Meanwhile, the remark of 'walking from the big unit to a small unit' might have been introduced to help students remember that a unit measure of a kilometre is longer than a unit measure of a metre, in doing that, Ms Taleni appeared to objectify units of measures (km and m). By objectifying kilometre and a metre, the researcher means that the teacher assumed reality to mathematical concepts of metres and kilometre. In other words, Ms Taleni presented them as physical objects. Walking from the big unit (km) to a small unit (m) projects these unit measures as two fixed points that are positioned apart from each other. The point here is, could this probably lead to such connotations, or would it lead to the conception of these concepts as magnitudes and sizes of length measure? Research might be required in this area.

Another question remained: To what extent does this make a learner realise that when one talks about converting a metre to millimetres, one is trying to determine the same length in a different unit of measure? Alternatively, does this strategy make a student realise that if they walk a distance of 1km and measure the same distance with a metre stick, they will fit it in a thousand times? Some students might realise this straight away, some might do so at a later stage, and still others, probably not. Perhaps the choice of words could do a better job. Perhaps if 'walking' were replaced by 'changing from', this might give a different perception.

The argument here is that while the mnemonic of walking from the big unit to a small unit suggests to students that they are required to multiply by a certain number, it does not seem to bring about the realisation that having a distance of a thousand metres is the same as having a distance of one kilometre. Instead, while it is used as a springboard to getting the answer, it also encourages rote memorisation – all a student has to remember is this rule: 'whenever we convert kilometres into metres, we need to multiply'. While Dowling (1998) made reference to the expressive domain of metaphors, this can be termed as the *expressive domain of rules and mnemonics*.

After this, Ms Taleni introduced another strategy. The next excerpt displays how her lesson proceeded and demonstrates how one of Ms Taleni's students construed what was learnt earlier as one of the normalities of mathematics lessons.

Excerpt 27

((Teacher writes 12.8M on the chalkboard))
T: *Ok. 12.8 metres into millimetre. Twelve point eight times-*
What is the relationship between metre and millimetre? Erastus.
Erastus: *One thousand*
T: *It is one thousand … ok. Then … how many zeroes do we have in one thousand? Kanime.*
Kanime: *Three*
T: *They are three. How many times are we going to move our decimal point?*
Kanime: *Three times*
T: *Three times. Forward or backwards?*
Kanime: *(forward … backwards)*
T: *Backwards? Now … which is it? Backwards or forward?*
Kanime: *Forward.*
T: *Forward. Why forward?*
Kanime: *[silence]*
T: *Mm? Why forward?*
Kanime: *That is the way we do it.*
T: *Because that is the way we do it? No. Because we are multiplying … we have to move forward. Ok. Then it will be … one … two ... three … then you add zero. Then it will be- [Teacher*

writes 12,800 on the chalkboard.] Ok. Those are the numbers.

After introducing the walking strategy, Ms Taleni introduced another strategy to help her students to proceed well in learning the mathematical concept of conversions. Ms Taleni mentioned that the relationship between a metre and a millimetre is 1000. Then she asked her students to take note of the number of zeroes in a thousand (three zeroes). Mentioning that there are three zeros in 1000, Ms Taleni asked her students the number of times they had to move a decimal in (12.8 metres) and whether the shift was going to be a backwards (left) move or forward (right) move. As one could see here, whereas the direction of movement depended on whether students were dividing or multiplying, the number of steps to be made was determined by the number of zeroes in the power of 10. Thus, when dividing or multiplying by 10, one step has to be made in a particular direction, and by 100, two steps have to be made. In *Excerpt 27*, students were to multiply 12.8 x 1000. Therefore, they were to move the decimal right (forward) in order to get 12800 millimetres. The strategy of moving a decimal backwards or forward is an attempt to visualise the conversion of, or the transition from 12.8 metres to 12800 millimetres. The idea of suggesting that a thousand represents a relationship between kilometres and metres, a move backwards and forward denotes division or multiplication, and a move according to the number of zeroes denotes a transition in place value positions are all examples of expressive domain strategies. A rule or procedure introduced here can be termed an *expressive domain of rules or procedures.*

Similarly, while to some students these might have been interpreted as springboards for visualising a transition from metres to millimetres or a transition from tens units and tenths in 12.8 to 12800, to a student like Kanime, this strategy did not appear to have made sense at all. Kanime took it as a normal habit or a routine in a mathematics class. When a teacher asked him how many zeroes they have in a thousand, Kanime knew it is three. When Kanime was asked about the direction of movement (where to move the decimal point), he also knew that it is to be moved forward. However, when Kanime was asked to give the reason why the decimal was to be moved forward, he responded ‘that is the way we do it’. It appears that to Kanime this was a routine, just one of those things that happened in a mathematics classroom. Since Ms Taleni did not get the answer she expected, she disagreed and then corrected Kanime: ‘Because that is the way we do it? No. Because we are multiplying … we have to move forward’. In real life, students walk real distances, while in class, students engage in conversions of units of measure. Probably, Kanime needed extra explanation than just ‘because we are multiplying … we have to move forward’.

Ms Olivia's approach to recruiting the everyday

The next exemplar presents an incident from grade 5 lessons by Ms Olivia. Ms Olivia was teaching a new topic about comparing and ordering masses. Apart from highlighting different versions of the expressive domain by different teachers, *Excerpt* 28 highlights the fact that some teachers appear not to draw the distinction between mathematics and everyday non-mathematics activities. After announcing that the class was going to proceed with a new topic about comparing and ordering masses, the interaction proceeded this way:

Excerpt 28

T: *What is to compare? When you hear of the word comparing, what will come in your mind?*
Sos: *To find the difference. To find the relationship between the two numbers. ((The teacher writes 5g 3g on the chalkboard))*
T: *When I say compare the two masses, what will be your answer?*
Samuel: *5kg*
T: *I said compare … compare the two masses … the two masses.*
Lucia: *It means three is less than five.*
T: *Mh. That means … what will come in your mind is the relationship sign … ne. We are finding the relationship sign. The definition is already in your book.*

In this introduction, Ms Olivia begins the lesson by testing what students know about comparing or what it means to 'compare'. Students answered that when one compares two numbers for example, it is finding the difference or the relationship between them. The students' answers did not satisfy Ms Olivia. She wrote 5g 3g on the chalkboard. She then asked the next question: 'When you hear the word "comparing", what will come in your mind?' Perhaps Ms Olivia hoped this would make a difference by prompting a better answer. However, these expressions did not seem to make much difference, particularly to a student named Samuel. The legitimate criteria for answering the teacher's question might not have been clear to students as yet. Perhaps Samuel misunderstood the question. Ms Olivia tipped off the class that they were required to compare the two masses. Lucia's answer seemed to be a better answer, but still, it was not the answer Ms Olivia expected. Ms Olivia then told students what she expected: 'What will come in your mind is the relationship sign'. Thus, from the teacher's point of view, when students talk about comparing in a mathematics class, what should automatically come to their minds are the mathematics symbols (<, > and =), which she called relationship signs.

The teacher's remarks (When you hear of the word 'comparing', what will come in your mind? That means … what will come in your mind is the relationship sign … ne.) appear to suggest that Ms Olivia had earlier made an assumption about what her students would know. Ms Olivia's expectation was that once a student hears the word 'compare', what should automatically come to their mind is the mathematics symbols (i.e. <, =, and >). For a number of reasons, such an assumption is not incontestable. The next excerpts aim to display further how Ms Olivia recruited the expressive domain text to help her students learn about the mathematics signs of greater than (>) and smaller than (<).

(i) Eating with siblings – greater than sign signifies wide open mouth

Ms Olivia's lesson proceeded with the basics introduced earlier – the relationship signs. Ms Olivia recontextualised a domestic setting of eating and sharing meat with siblings. The rest of the dialogue and Ms Olivia's approach to bridging mathematics and the everyday in a classroom proceeded in this manner:

Excerpt 29

T: *What are the three relationship signs that we are using when we are comparing? Kamati.*
Kamati: *[silence]*
T: *We have learnt them. Katilamukaa.*
Katilamukaa: *Greater than*
T: *Greater than. Nangy.*
Nangy: *Equal*
T: *And equal … ok. ((Teacher writes <, >, and = on the chalkboard)). This one is the sign for which one? Mm?*
Tuuliki: *Greater than … Less than.*
T: *You are guessing. Remember … we must differentiate. We said when we are eating with our small brothers and sisters. What do we do? There is a bowl with a piece of meat. You are two, and you are eating with your little brother, and you are the elder one. Then you have to take the meat first, ne?*
Ss: *Yes*
T: *Because you are big … ne?*
Ss: *Yes*
T: *Which one will you take? There are two pieces … one is smaller, and the other one is big.*
Peter: *Big*
T: *You will take the big piece. That is why the mouth is open to eat up the big number … ne? Ok. ((Teacher explains as she points to the 'less than' sign)).*

Ms Olivia proceeded and asked her students what the three relationship signs were. While students such as Katilamukaa and Nangy recalled the names of relationship signs, Tuuliki did not differentiate between the signs as to which one was smaller than and which was greater than. To help her students differentiate the signs, Ms Olivia relied on the expressive domain and casts a gaze on non-mathematics context. She recontextualised a domestic practice of eating with siblings. Ms Olivia explained that when students are eating with their younger brothers, the elder had to take the meat first because they are older. Furthermore, she explained that being the elder, the student is entitled to a bigger piece of meat than their younger brother or sister.

Following the aforementioned explanation, Ms Olivia pointed to a less than sign (<) and says ‘That is why the mouth is open to eat up the big number’. This means that when one has an esoteric expression such as $3 < 5$, the number on the right of the relationship sign (<) is the biggest because that is where the wide mouth opens, ready to eat a bigger number. In this case, five is the bigger number than three. Similarly, in an expression such as $5 > 3$, the number on the left of the relationship sign (>) is the biggest because that is where the wide mouth opens to. The approach works well because, in any case, the mouth opens to eat the bigger piece. This example is one of many that highlight the positive side of a perspective and mythologising non-mathematics activities. Similar to the example metaphor of a ‘machine’ introduced by Dowling (1998), open mouth is another metaphor to denote both > and <. That is, in both of these cases, $5 > 3$ and $3 < 5$ hold, and both less than and greater than are denoted by big mouths. Again, this is an example of what the researcher terms the expressive domain of metaphors and metonyms.

Presmeg (1997) contended that any mathematical statement in which a symbol stands for a class, a principle or some mathematical concepts such as in “Let x be an integer...” or “Let ABC be a triangle” is a statement that uses a metonym. In this case, a metonym is a special case of a metaphor, and for this reason, metonyms and metaphors are grouped together. Apart from the idea of metonym of Presmeg (1997) (Presmeg contended that any mathematical statement in which a symbol stands for a class, a principle or some mathematical concepts such as in ‘let x be an integer’ is a statement that uses a metonym), looking at the strongly institutionalised term (i.e. find) as well as the mathematics expression ($2x + 1$), one could also conclude that a metonym could be classified as an esoteric text as well. Looking at Presmeg’s articulation regarding a metonym and Dowling’s characterisation of the exoteric domain, one could suggest that whether a metonym is an expressive or esoteric domain text is debatable. In summary, phrases from *Excerpt 29,* which point to the expressive domain, are displayed in Table 10.

Table 10: Summary of recruited phrases

	A sign	
	signifier	**signified**
Expressive domain texts	*Wide open mouth*	> and <
	Bigger piece of meat	Bigger number or greater quantity

Although the approach in Table 10 appears to work well when a student compares two numbers, it seems that it cannot do a productive job if the subject content advances. Specifically, this becomes the case when a student compares quantities in different units. In other words, this expressive domain strategy becomes unuseful if the units of measure are not the same. The next excerpt from the same lesson highlights this argument.

Excerpt 30

T *(proceeds): Now let's look at the example. ((The teacher writes these examples on the chalkboard)). Use (<, >, and =) to make each statement correct:*
a*) 4.5kg __ 400g* ***b****) 0.25kg __ 25g. Ok. Now what you have to put in your mind … don't look at the number. Don't consider the number … ne. But consider the unit … ne. First imagine you look at your units. Are the units the same? Then if they are the same, then you look at the number. You look at the number … which number is bigger than the other ne. But if they are not the same, what can we do? If the units are not the same- Because the first one- like we were having 5g and 3g ne. They are all the same. I mean all the units is gram ne?*
Ss: *Mmm*
T: *They are all having gram … gram. We just looked at five, then we know five is greater than three.*
Now if the units are not the same, what can we do?
Ss: *[silence]*
T: *What can we do if the units are not the same? Olivia*
Olivia: *You multiply*
T: *You multiply?*
Olivia: *Yes*
T: *Multiply which one? Multiply 400g or 4.5kg?*
Ss: *[silence]*

T: *Haa? We are not multiplying, but what can we say? We are not multiplying.*
Not every time that we have to multiply. But what is the correct word? Ndengu. What are we going to do if the units are not the same?
Ndengu: *We look at the unit and see if it is big.*
T: *Ee … and if it is big?*
Ndengu: *[silence]*
T: *You look at the unit which is big, ne? ((Teacher writes 5000g _ 2kg)). Now you look at the unit which is big … ne? Ee … if the unit is big, what does that say? If that unit is big, then that is the big number … mass? Like 5000g and 2kg.*
Because a kilogram is bigger than grams, that means 2 kilogram is bigger than 5000g? Is that what you were trying to say?
Ss: *[silence]*
T: *What are we going to do? What about the yesterday's lesson? What do we have to do there? Titus … you were not here yesterday?*
Titus: *I was*
T: *Ehe*
Ss: *Plus*
T: *Aa a. We are not plusing! [Sic]. Not the four basic operations. Kanime.*
Kanime: *Compare*
T: *We have to?*
Kanime: *Compare*
T: *Not compare, but?*
Selma: *Convert*
T: *Convert. We have to convert and make it the same unit … ne.*

In *Excerpt 30,* teacher Olivia was teaching grade 5 learners. Students were given a text such as (a) 4.5kg __ 400g and were asked to use <, >, and = (*relation signs, wide open mouth*, and =) to make it correct. Although kgs and grams have a point of reference in the everyday world, considering these learners' grade level, one might say students were given an esoteric domain text. There has also been a move from the expressive domain to the esoteric domain. Ms Olivia hinted to her students on what they should put in mind. With regard to comparing 4.5kg __ 400g, she cautions: (1) *don't look at the number,* (2) *don't consider the number … ne. but consider the unit … ne,* (3) *first imagine you look at your units, and* (4) *see if the units are the same.* In other words, Ms Olivia, asked (1) students not to look at the numbers (i.e. students are asked to ignore some aspect of the given problem, thereby following the lead blindly). Students were not considering the number but the unit, and this also means that the number and the unit are not to be looked at simultaneously. (2) Just for a while, students had to imagine they are looking at the units only. This helps the students to see if the units are the same or different. The students appeared to be struggling.

These hints did not seem to help them much in terms of facilitating the move from the expressive domain to the esoteric one.

When Ms Olivia asked students what could be done if the units were not the same, there was silence in the class, and Olivia could not give the answer. Ndengu answered that one has to multiply. Although the question asks students to compare the two quantities, what might have transpired in Ndengu's mind is what was learnt in previous lessons. In the previous lesson, Ndengu learnt that when you move from a bigger unit of measure to a smaller unit of measure, you have to multiply. To clarify the student's response, Ms Olivia asked 'Multiply which one? Multiply 400g or 4.5 kilograms?' Still, there was silence in class. Perhaps no one knew the answer, or perhaps Ndengu just regurgitated the mnemonic learnt previously.

It appeared that Ndengu was not the only student who was lost. Ms Olivia shifted her question to Titus and reminded him what he learnt in yesterday's lesson. Other students responded that they had to add. Kanime thought they were comparing as it was announced at the beginning of the lesson (comparing masses), but this was not the correct answer the teacher expected. Perhaps Kanime was right. If one followed the teacher's hints by ignoring the numbers and paid attention to units, one could see that kilograms are heavier than grams, hence 4.5kg > 400g. When she was teaching about mass, these were not the terms the teacher was using. Ms Olivia remained with *big* and *small* terms (as in big unit or piece). Though the teacher wanted the students to say that they had to convert, *conversion* was not hinted at the beginning as one of the lesson's outcomes. The two lesson outcomes were to be able to compare and order masses. Finally, Selma mentioned the desired answer – to *'convert'*.

To some extent, these incidents highlight some strengths and weaknesses in recruiting and relying on the expressive pedagogic mode of action alone. There are times when this particular approach to making links can be successful, and there are also times when it reaches its limits and becomes insignificant or useless. On the other hand, the excerpt also highlights that by recruiting expressive domain strategies, the construction of meaning by the students may either be limited or expanded. Additionally, the excerpt highlighted the advantage and disadvantage of recruiting mnemonics. The advantage is that it helps students to recall what they were taught previously. The disadvantage seems to be that it might make students become more dependent on mnemonics. Students might become more dependent on mnemonics to the extent that they might not be able to know why they have to use specific signs, especially when circumstances change. Students may not be able to sort out circumstances that require comparing quantities, converting between units of measure, or multiplying.

6.10 Conclusion

This chapter presented some of the ways teachers attempt to bridge the academic and the everyday in a mathematics classroom. During their practices, teachers appeared to have put forward different kinds of metaphorical ideas, but navigating from the public domain to the esoteric seemed very hard. They either stayed there or they jumped right over. There is a route that teachers did not appear to take, and this is the descriptive domain. This chapter developed a systematic analysis used to look at ways teachers bridge mathematics and the everyday. Through this analytic strategy, trajectories that teachers used in their lessons were determined. Through this approach, it became apparent what domain of actions teachers recruited and operated on. Through this lens, it was also possible to see what domain was dominantly recruited by teachers and which one was used the least. The conclusion that was reached is that the public domain was mostly used by teachers followed by the expressive domain.

There was a single example which seemed to point to the descriptive domain strategy. Lack of frequency of the descriptive domain in these lessons suggests and points to the disappearance of mathematical modelling from mathematics teaching and learning in the observed classrooms. The type of analysis employed in this chapter, particularly the one that identified categories of texts according to the domain of actions and eventually the patterns of teacher practices, could be useful in analysing dialogic texts in any classroom. The researcher described what she views as the struggles associated with the bridging of the academic and the everyday in a mathematics classroom. Finally, the researcher proposed and categorised what she construes as different categories of expressive domain, a route that Dowling (1998) seems not to have taken during his discussion of the DAS scheme.

The next chapter will discuss localising task contexts, recruited contexts and their implicit pedagogic message.

7 Localising task contexts, recruited contexts and their implicit pedagogic message

7.1 Recruited contexts and the implicit message of professional identity

When Dowling (1998, pp. 145-149) analysed the distribution of 'voice', it seems he only looked at different positions within the mathematics activity and not the distribution of voice according to the types of contexts or activities recruited. This made it necessary to analyse and distinguish between the sorts of contexts/settings or activities recruited by teachers while bridging mathematics and the everyday in a mathematics classroom. It might also be of interest to determine which social group they refer to. In terms of the type of contexts, it might be very interesting to determine what type of professional identity they might suggest in terms of student-intended knowledge and future careers. Depending on the type of contexts recruited, one might consider this as anticipating different professional identities for particular students.

In view of the foregoing, recruited contexts were categorised according to specialised and non-specialised contexts. Specialised contexts are those that have to do with some form of specialised training or are likely to point a student to a career. The researcher wanted to determine if she could find a pattern in these contexts. For example, she needed to know if there were some career paths or something envisaged for students via the contexts used by teachers. What do the types of contexts used by teachers suggest with regard to future professions or the professional identity of the students being taught? This is what the researcher referred to as embedded message, or distributed voice. In other words, she needed to determine if possibly there are different positions with regard to the type of contexts employed by teachers.

It was cumbersome to categorise contexts according to specialised and non-specialised because contexts were kind of normal activities for people, which are not specialised. The types of contexts that were employed were all from the living contexts of students, and there was not much difference. The researcher felt that perhaps she did not need to have this type of classification or category anymore. For example, the use of farming did not point to a career in farming or specialised farming or vocational training. Almost all teachers used contextualised tasks in their lessons, except one teacher whose lessons were more on introducing procedures that enabled students to get along and get answers. The contexts used range from domestic to economic and social.

Contexts were, for example, about girls cooking ‘Oshifima’ (porridge). These included how girls make sure that the flour is enough for the porridge and whether the porridge is enough for everybody. They also included shopping for 1kg of sugar from Spar, determining money change, buying clothes and other items such as chips, cool drink or milk, buying food and drinks such as cool drink and chips, identifying items and their prices, and calculating costs and change (economic contexts). Moreover, the contexts were about measuring Ombaduyekaya, measuring the volume of a stomach to determine how much one needs in order to be satisfied (dead mock reality context), measuring a piece of land ploughed by a tractor, getting a piece of land from the headman, and measuring farmlands by the headman. Additionally, they comprised determining the walking steps of the students’ teachers, naming instrument of measuring irregular objects such as millet at ‘ohashida’, discussing stories of tribal conflicts (moral values?), and discussing getting married in the olden days (significance of social events?). Furthermore, the contexts may have to do with changing of dollars to cents, asking learners to name the distance from their homes to school in metres or kilometres, locating or directing somebody to a house in the village (according to number of trees in between), naming the number of square kilometres their school has, saying the same statement in different local languages (e.g. this is my house), and naming or listing Namibian money.

Other contexts recruited seem to point to specialisation but were quite general in terms of their setup. One of the contexts recruited was an example of a person who wanted to get to the top of a building. From the minimal information on the task context, it was not clear if this person was a village boy wanting to get a ball from the top of the building, a builder or a painter who wanted to get to the roof to paint. Other contextualised examples that seemed to point learners to a specialised career were: an athlete running certain kilometres per day as part of his training routine; and a shoemaker cutting shoelaces of a certain length from a shoelace of a specified length. Still, it was again not clear whether this athlete is Frankie Frederic of Namibia or Maria Mutola of Mozambique training for the Marathon in Maputo or for the Olympics in the United Kingdom. Perhaps the year in which this took place will also suffice (if necessary). It was also not clear from the contexts whether the shoemaker was in the shoe factory or was an ordinary person doing it at home without mathematical procedures. More specifiers in the setting up of the task context could have made the task context clearer, specific, and more meaningful. Alternatively, perhaps the additional specifiers could have distracted the learners from the mathematical components of the task. The dodecagonal chart in *Figure 11* summarises contexts employed by teachers during their practices of making links.

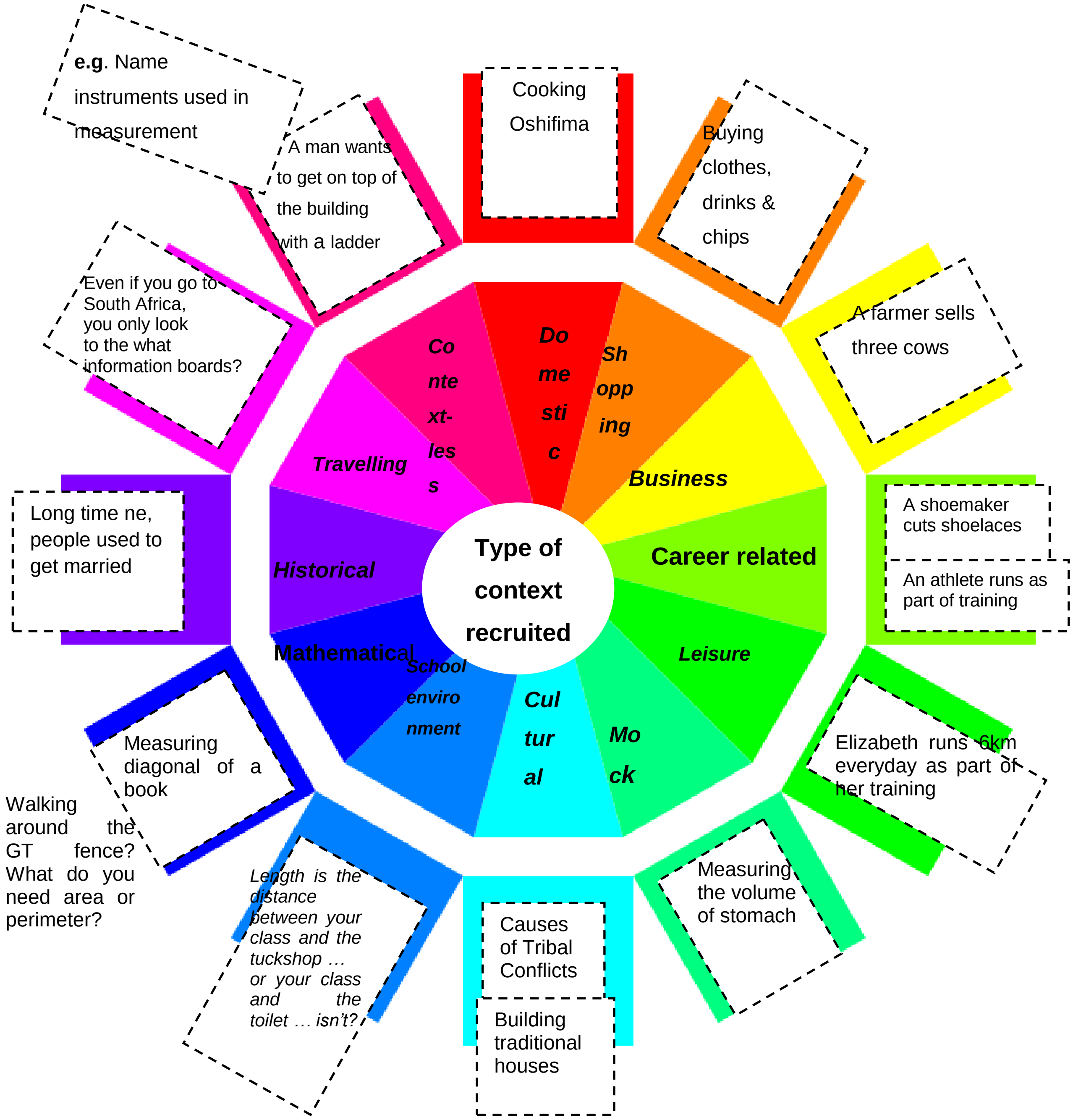


Figure 11: Summary of contexts employed by teachers during their practices of incorporating the everyday in the mathematics classroom

Depending on the topic discussed in mathematics lessons, one would expect to see a range of contexts recruited. These could be contexts that draw from health and economic sectors, social welfare, tourism and industry, safety and security, religious denominations, professional jobs, just to mention a few.

This subsection presented the type of contexts recruited by teachers. Based on this background, the next section will introduce and discuss what the researcher supposes could be taken as ways of localising teaching, or strategies for localising task contexts.

7.2 Modes of localisation

Mathematics topics, concepts, and general methods can be taught through localised examples. By localising, reference is being made to the attempt to position tasks or frame them within the aspects of the local environment with the purpose of bringing about meaning, engagement or motivation among the learners being taught. Judging from the setting up of contexts recruited by teachers, it appears that in each task, there are *specifiers* which will be referred to as *modes of localisation*. In other words, localising task contexts seems to be done in different dimensions. It can be done by including or excluding some of the following specifiers: protagonist(s), actions, aims, time or period, space (place or location), and in conditions (specifications or conditions for the action). Protagonists refer to the main characters in a task context or story or work to be done. In other words, they are the subjects or actors in the story. Action is what needs to be done, and aims are the rationale behind their action. Time refers to when the action happens, or is to happen, or for how long the action has been under way. The space refers to the place or the location where the action is to take place or where something happened. Conditions refer to ways in which something happened.

The degree of modes of localisation appears to determine the extent of specificity or how detailed a task context is. This means a task context can be considered either more localised or less localised. In other words, the setting up of the task context became more specific as one introduces more specifying elements. The more modes of localisation (specifiers) present in the task context, the more localised the context is, the more detailed it becomes, and the more it moves towards specificity. The less localised the context, the less specified or detailed it will be and the more it moves to a general task context. A task became general if some modes of localisation such as actors (e.g. people), time, and aims are left out or disappear. *Table 11* highlights modes of localisation, shows how these modes were organised, and displays some of the exemplars from the empirical data, as well as how these exemplars led to the creation of Table 11 and the hexagon in Figure 12.

Table 11: Task and specifying elements

			Specifying elements					
		Exemplars from empirical data	***Protagonists***	***Action***	**Aim**	***Time***	***Space***	***Conditions***
Setup of task context	**Specific** (*if it contains 1 or more specifying elements*)	**More localised:** E.g. *An athlete runs 5.83 kilometres per day as part of a training programme. A … Calculate the distance to the nearest metre in 12 days*.	An Athlete	Run 5.83 km	As part of his training	Per day	x	Run 5.83 km
		Becky … how many kilometres are from your home to school?	Becky	*Criteria not clear. Estimate perhaps?*	X	X	From her home to school	X
		Less localised: E.g. Girls … how do you cook Oshifima?	Girls	Cook Oshifima	X	X	X	X
	Generalised (*there is an action but no other specifying elements, or no specifying elements at all)*	**Less generalised:** *In each case, state whether you need to know the area or the perimeter.* *a) Covering the board with posters.*	X	*Covering the board with posters*	X	X	X	X
		b) What if ***people*** *want to put the tiles? What do they need to know? The area or the perimeter?*	X	*Put the tiles*	X	X	X	X
		More generalised: *T: What is the distance or the difference between kilometres and metres?*	X	X	X	X	X	X
		3) *Convert or change 2kg to metres. or How many metres are in 2kg?* *4) Simplify 3/6.*	X	Convert & Simplify	X	X	X	X

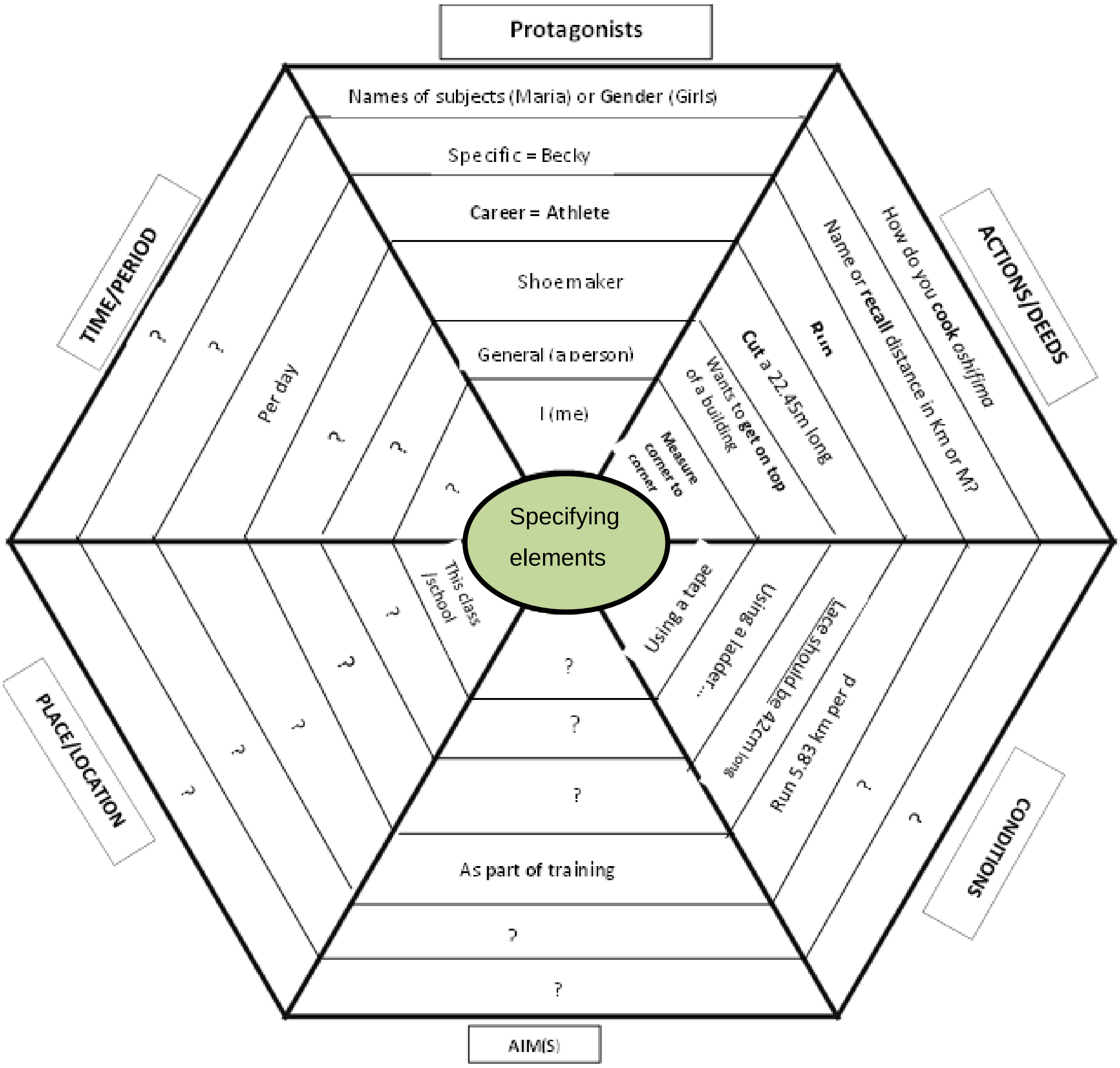


Figure 12: Specifying elements/modes of localisation which are a simplified and summarised version of Table 11

Figure 12 proposed what the researcher termed the modes of localising task contexts. Some of the ways teachers link school mathematics and everyday life will be discussed next.

7.3 Versions of making links

There may be many approaches to incorporating the everyday in the mathematics classroom. Figure 13 depicts some of the ways teachers recruited in their mathematics lessons. Instantiations that explain *Figure 13* follow next.

Versions of bridging mathematics and the everyday in a mathematics classroom

- Drawing on student experiences by using immediate and far contexts
- Use of repertoire of everyday terms as springboards for meaning-making
- Made-up stories (dead mock reality)
- Shift mathematical ideas from the non-mathematics for discussion in mathematics lessons
- Capitalising on or reaching to local language
- Mimicking/simulating real-life contexts, e.g. buying and selling
- Seek rationale for instructing and learning specific mathematics content
- Devise rules and procedures for helping learners get around the math problem

Figure 13: Versions of making links that teachers employed while bridging mathematics and the everyday in a mathematics classroom

It is not only teacher-initiated ideas of bridging which are discussed and explored during mathematics lessons – student-initiated ideas are also pursued. Teachers might ask their students where they have seen mathematics concepts being used in everyday life. In what could be teachers' conception of mathematics application, Ms Helao asked her students 'Where do we use percentage in everyday life?' This posed question is in line with one advisor's proposal on the ideal implementation of the curriculum declamatory statement.

Teachers incorporate immediate and non-immediate contexts as a preface for introducing mathematic ideas. For example, before introducing the concept of length, Mr Kafula posed a question to one of the students, '*Becky, what is the distance between your home and the school*?' For non-immediate contexts, the teacher narrates how mathematical ideas develop over time by drawing on historical contexts. In one of the lessons, the teacher recounted how people used to measure traditional tobacco (O*mbadu tekaya*). In promoting the utilitarian aspect of mathematics, teachers also recruit exemplars that include distant places. These are places such as those in neighbouring countries. This finding coincides with the findings of Sethole (2004) on learners' perspectives regarding the incorporation of the everyday into mathematics.

Teachers use the repertoire of everyday terms that are incorporated to communicate mathematical meanings. Everyday terminologies are used to signify mathematics entities. For instance, in one lesson, Mr Kafula waved his hand and used the term 'space' to denote the mathematics concept of area, while Ms Taleni in Excerpt 13, used the names of animals to signify units of measure. In teaching the mathematics object p^2 (p to the power two), Mr Kafula used the phrase *repeating itself* to explain the concept 'square'.

> *People this means we have something repeating itself. Just like in a letter … P to the power two. It does not mean P times two. I mean P times two. No. This means P repeating itself twice. Therefore this one is wrong. This means three repeating itself twice. That is why people when we come to the measurement here, this is what we call- a square.*

Everyday terms are also used to denote mathematics relationships rather than mathematical concepts or objects. Teaching about magnitudes of units of measure for *length,* Ms Taleni communicated that the relationship between centimetres and metres is one hundred. She not only described 100 as a relationship between a metre and centimetre but also refers to it with terms such as '*difference'* and '*interval'*.

> *Then again … you must know the relationship between the two units. The relationship between centimetres and metres. Then this … aam … Shikwa found out that there is a difference or there is an interval of one hundred. That is why we multiplied 22.45 with 100, ok.*

Different from Ms Taleni, Mr Kafula used words such as '*distance'* instead of *'interval'* to outline the difference between kilometres and metres.

> ***T:*** *Now what we are going to look to is the Area. But before that one, we said for example in the case of the length- from kilometres to metres … what is the distance or the difference between kilometres and metres?*
>
> ***S:*** *One thousand*
>
> ***T:*** *Between metres and centimetres?*

All these texts show different expressive domain strategies teachers use to communicate meaning in mathematics. Table 12 summarises these.

Table 12: Signifying a square and relationship between a metre and a centimetre

Signifier	Signified
Repeating itself	$P \times P = P^2$
The relationship between centimetres and metres	100
Difference' between centimetres and metres	100
'*Interval'* between centimetres and metres	100

Teachers develop stories (dead mock reality) in the name of mathematics application. In one example, the teacher made up a story telling his students that if they want to know how much they need in order to satisfy their stomachs, they must come to school. They have to come to school because they need to know the volume of their stomach. *Excerpt 31* highlights the interaction between Mr Kafula and the students in that particular mathematics class.

Excerpt 31

T: *If you want to know how much you need in order to satisfy. Ila kofikola opo u ha nyokomwe. (Should you need to know how much you have, come to school so that you will not be cheated).*

Ss: *[Laughter]*

T: *Eee. Eee? You must know the volume of your stomach ... hasho (isn't?).*

Tery: *Aaye (no)*

Nangula: *Yes*

Terry: *I cannot*

T: *You must know the volume of your stomach.*

Sos: *Yes … No … Aaye (No).*

T: *Eee?*

T: *Oh … you have to measure the food you eat … isn't?*

Terry: *Oh!*

Ss: *Aaye (No)*

T: (( ))

Shetu: *Maar yes (But, yes)*

Jonas: *No*

T: *Eee?*

Mark: *No*

Shetu: *Yes Bra ove. Ngeenge okayaxa okashona, i to kuta mos. Maar ngee oka kula ndee owa fya ondjala oto dulu okumona kutya paife ngaha onda kuta. (Yes, bro. If the plate is small, you will not be satisfied. But … if it is big, you can feel that now you are full).*

Although this attempt may have been another way of promoting the utility of mathematics, a number of students could not agree with the teacher on this one. If the aim of recruiting this context was to develop an appreciation of mathematics' object of volume, this might not have worked either.

Teachers shift mathematical ideas from non-mathematical contexts for discussion in the mathematics class. In doing this, teachers may recruit traditional and historical contexts. They might draw on national issues such as tribal conflicts as a strategy for contextualising maths content. For example, one teacher told his students a story about ways to get a piece of land from the headman and how it resulted in tribal conflict.

When bridging mathematics and the everyday, some teachers capitalise on local language by code-switching. While discussing ancient units of measures with his grade 8 students, Mr Kafula explained:

Excerpt 32

T: *They were using sticks. That is how they were measuring time. And then, during the night, they use the stars.*

Kavena: *And chicken*

Clarke: *Oh*

T: *They use the stars. And what?*

Ss: *Chicken*

T: *Chicken like a cock.*

Ss: *Yaa. A cock. Yah*

T: *A cock. Very good.*

Sheni: *What about the sun?*

T: *Ee?*

Ss: *The sun*

T: *The sun?*

Ss: *Yes*

T: *Iyaaa [hesitation]. How do they use the sun?*

Ss: *Yaa (yes), they use the sun.*

T: *The sun*

Ss: *Yes*

T: *It is something very difficult. We only use it when um- also the sun? Fine, the shadow maybe.*

Mark: *The shadow? No. When using the sun, you just-*

T: *Iyaa, do you know how they count the stars? The starts ne. Eanyothi di nya ha di kala da ninga oshike. Eanyothi di nya ha tiwa Oshothi, Okalimbanombwa. (Those stars which are called Oshothi and Okalimbanombwa) When you look at them, they look like a dog chasing a what?*

Ss: *A hare?*

T: *Ehe (yes). Sha fa ashike ombwa tai taata okalimba nga he. Maar oha di yako ashike ethimbo limwe eshi taku hala okusha nga he. Can you see now? Iyaa, noshothi. Oshothi onyothi imwe ilipo ya kula.buta big star. Ota shi ti oku li pokusha nee ngaho. While the cock every*

hour, every hour kuukulushu (croak!), kuukulushu (croak!).
***Nghihepa:** Yes*
***Ss:** [laughter]*
***T:** Yah people, measurement has been used for quite long. Long, long time ago, before people need to read and write, you know. Iyaa. That is why you won't find them late. Aakulunhu nale ka kwali hava lata nande. Now we have watches. You know the time very well, but you use to be late. Even in our days when I use to go to school you won't find me late, because I am only time those shadows, you know. This time, ooh, I am on time now. Even if it is late. You take a stick ne.*

Teachers mimic or simulate contexts as pretence of engaging in real-life activities or situations. When teaching money and finance, for example, teachers may bring in real money and act out with their students as if they are involved in buying and getting change. A lesson by Ms Dorkas was a typical example of this.

The pursuing rationale behind mathematics content instruction might have been perceived by the teacher as another way of making links. Teachers seek reasons from students for learning specific maths topics. This is usually as a preface to teaching a main idea or concept in mathematics. Questions such as: "*Where have you seen percentages being used?"* or *"Why is measurement necessary*?" are typical examples of revealing why learning a specific topic or concept in mathematics is necessary. In lessons where there appear to be limited or no links at all, teachers devise rules or procedures as springboards to help learners get around the problem. The lesson presented by teacher Mr Sakeus is one example in this case, where he referred to this as tricks for students to follow (*see Section 6.5.2*). This section discussed eight points that might have been construed as an approach to bridging mathematics and the everyday in a mathematics class.

7.4 Conclusion

This chapter considered ways in which teachers can use certain specifiers in an attempt to localise task contexts. It highlighted that the sort of recruited contexts might carry a specific message to learners, which could go unnoticed. What seem to be teacher conceptions of bridging the academic and the everyday in a classroom have been highlighted. The concluding chapter will discuss findings, their implications, as well as the contributions of this study.

8 Discussion of findings, implications and contributions of study

8.1 Recapping the objectives of the study

Recent changes in mathematics education policy in Namibia have coincided with international trends in stressing the relationship between mathematics and non-mathematical practices. As discussed in Chapter 1, it is suggested that teachers in their classroom practice should establish a relationship between academic mathematics, which focuses on mathematical concepts and processes, and the everyday experience, knowledge and skills of students. This study attempted to contribute knowledge and understanding on how this is interpreted by subject advisors with curriculum responsibility and by teachers. To understand the enactment of curriculum aspirations in the classroom, teachers' practices were observed and analysed.

The literature review pointed to the potentials, limitations, and tensions associated with incorporating the everyday in the mathematics classroom. As the literature highlights, debates on the relationship between students' everyday experience, knowledge and skills on the one hand, and academic mathematics established in the mathematics classroom on the other, are ongoing and inconclusive. Proposals for incorporating references to the non-mathematical practices include progressive mathematisation and real-world, mathematical modelling as a means of developing mathematical meaning and increasing general competency in solving applied problems and to help students appreciate the usefulness of mathematics. Tensions were discussed from a sociological perspective and also in terms of drawing on the everyday to develop mathematical meaning. The lack of more in-depth investigations into teachers' practice motivated this study. The goal was to carry out an in-depth study that enables differentiation of ways teachers fetch from imagined everyday practice and explore their fruitfulness and limitations. This chapter will summarise the main lessons drawn from the study and will discuss the theoretical, methodological and pedagogical contributions.

8.2 Main lessons from the study

From observation of teacher-students interactions, various elements emerged of the everyday incorporated in different phases of the lessons and ways in which lessons were introduced and unfolded; a wide range of interpretations of making links with students' everyday experiences, knowledge and skills surfaced. This was also revealed in the different ways teachers interpreted the curriculum declamatory statement. A general observation is that the sort of everyday recruited (single everyday terms and concepts, stories, recontextualised activities and a range of practices indicated) has the potential to either facilitate mathematical understanding or limit student access to the esoteric domain of mathematics. Apart from this, as observed by Sethole (2005) and Wiliam (1997), when the everyday is recruited into mathematics teaching, it elicits different responses from the students and in general evokes some level of engagement and interest in learners. Some of the teachers' strategies observed in this study point to this function only.

This study shows that mathematics teachers do not have uniform practices but made their own interpretation of what it means to incorporate the everyday in their mathematics classrooms. Almost all of those who participated in the study mentioned students' everyday experience, knowledge, and skills either in their discussion of the curriculum declamatory statement and/or conducted their mathematics lessons in ways that incorporated it. As argued in the study, such drawing on what students know and can do is inevitable in mathematics teaching. The differences are in the ways in which this is done and what messages about the usefulness of mathematics are conveyed.

In contrast to what some teachers believed in the study of Sloyer (1976), this study of Namibian teachers reveals that incorporating the everyday in the mathematics classroom is not a straightforward endeavour. Inferring from their articulations on the mathematics-everyday relationship, the findings suggest that the teachers do not possess a differentiated repertoire for talking about it. In contrast to the subject advisors' positive stance towards the goal statement and more differentiated articulation, mathematics teachers generally did not read or pay attention to the declamatory statement or introductory pages of the syllabus more broadly. Their comparatively lower level of reflection in this regard is thus not surprising. Similarly, as Sawyer (2008, p. 429) indicated, consensus that students should learn how to make connections does not extend to agreement as to how students should be supported in doing so. There is no doubt that commonsense might remain the main source of reference. The vagueness of the process of incorporating the everyday might pose challenges not only for mathematics teachers in Namibia but also beyond. The policy implication here is that something may need to be done to augment teachers' knowledge, providing them with some differentiated and nuanced descriptions and analytical tools.

What the study further brings to light is that besides some commonality in commonsense notions among the teachers, there are also divergent interpretations. This divergence signposts the possibility of different teaching approaches, but also different views reflected in the notion of Dowling (1998) of mythologising. The three myths that featured in participants' articulations are those of participation, reference, and emancipation. These are the three common myths that also featured prominently in mathematics education materials.

The matter of concern here is not only what sorts of myths emerged from mathematics teachers' discussions but also how these myths relate to teacher approaches to the teaching and learning of mathematics. As Dowling (1998) contended, access to principles of academic mathematics cannot be realised under the myths of participation and emancipation. As discussed in Chapter 3 and in Section 8.1, this has the danger of increasing or sustaining educational inequality. The policy implication here may be to pay more attention to the descriptions of general aims in curriculum statements and to avoid contradictions between stated aims and recommended teaching approaches.

There was indeed some resonance between the way in which the teachers talked about the idea of incorporating the everyday in the mathematics classroom and the manner in which they conducted their mathematics lessons. It needs to be stressed that some form of mythologising cannot be avoided, as a teacher cannot teach mathematics without drawing on analogies and metaphors, which need to be taken from familiar contexts of the learner in order to work. The important question relates to when these myths can be discarded. This question is answered by pointing to differences in trajectories in classroom practice, which offer an analytical tool by means of which pathways towards mathematical theory can be described. Differences refer to the type of myth constructed, how long it is sustained, and how it can be overcome. As highlighted in Table 8 of Chapter 6, this study reveals that some teachers might stay longer in the public domain. Dowling (1998, 2007) maintained that both the myth of participation and the myth of emancipation are typical reflections of the public domain, and the myth of participation usually characterises texts intended for lower-ability students (Dowling, 1998, p. 34). If the culture of mathematics teaching in these classrooms is dominated by the public domain particularly in higher grades, one could speculate that those students are probably receiving a mathematical curriculum meant for 'less able' students. It may also be inferred from the same table that these particular teachers rarely engaged their students in the descriptive domain. The descriptive domain can be interpreted as a form of mathematical modelling which aims to leave the context behind in making explicit the mathematical focus. This has been pointed out by Gellert and Jablonka (2009).

Although Dowling (1998) identified six myths, only three emerged from this study. In particular, the myth of emancipation stood out, whereby teachers believed that mathematics existed even before the introduction of formal education and felt that mathematics is not imposed from somewhere but has always been part of the students. These remarks reflect the myth of emancipation similar to those identified by ethnomathematicians, although with no political intention such as that expressed by Gerdes (1988b, p. 152). What could be interesting for the field is that forms of proto-mathematical activities inherent in cultural practices are still valued by teachers in Namibia. If research on mathematics education continues to explore this further, outcomes could become useful resources for mathematics teaching and learning. This then has to be examined in terms of the confrontation of different forms of knowledge rather than perpetuating particular myths.

In contrast with some mathematics teachers who either disagree or caution about the use of the everyday in the mathematics classroom, Taylor and Vinjevold (cited in Sethole, 2004 and Boaler, 1993) highlight that both teachers and subject advisors have shown regard and value for incorporating the everyday. Teachers' articulations concurred with the common understanding that mathematics is made more meaningful when it is rooted in 'real-life contexts'. What is not clear from participants' statements is whether teachers and subject advisors are aware of the tensions involved. Further research might need to look into this from the teacher's perspective.

The study also reveals that some mathematics teachers did not understand the declamatory statement in the curriculum. In particular, some of its terminologies that suggest the incorporation of the everyday, for example, 'local contextualisation', did not make sense to some, and yet these teachers incorporated the everyday in their teaching. This could probably mean that teachers incorporate the everyday because they feel doing this is necessary and not because it is demanded by the syllabus. The lack of understanding of this part of the curriculum and the attributed lack of relevance of introductory sections in general could be worrying for Namibia. The policy implication here is that teachers' understanding of mathematics curriculum guiding statements could be improved if it is shown how they might be realised in both the syllabus and in assessment. In the context of curriculum change or development, teachers' understanding is quite pivotal in the implementation of the curriculum.

The foregoing also relates to the observation that mathematics teachers only rarely use this particular declamatory statement as a reference in their planning of lessons. While they all agreed on the importance of 'real-life contexts', it appears that the lesson planning does not contain much reflection on how this would be realised in detail. Hence, the contexts, stories, and metaphors appeared to evolve unplanned in the interaction with the students. The study, however, shows that attention to detail is important. While subject advisors put emphasis on the mathematics syllabus as a whole, mathematics teachers tend to focus on competencies and assessment, as this is what they believe to be important for students. The significance of the mathematics curriculum needs as a whole requires to be emphasised. Teachers' acknowledgement that they do not pay attention to general introductory statements concurred with what subject advisors assumed to be the case.

If the presence of the statement is significant but teachers are known not to be paying attention to it, this raises questions as to the purpose of these curriculum guiding statements and for whom they are actually written. The question of the intended audience of curriculum documents, which might include parents, stakeholders from industry or business or teacher unions, deserves further attention.

One major finding of the study relating to teachers' practice concerns the diversity and lack of uniformity in linking the everyday and the academic in the classroom. While for good reasons mathematical topics are perceived as the main ingredients of the curriculum, prescription of other elements arises in particular as one of the main goals. If some form of standardisation is necessary among teacher practices for incorporating the everyday, for example, in avoiding distributive effects, then future research could possibly look into this avenue.

Given the divergent interpretations of the notion of including 'real-life contexts' across the teachers, questions arise as to where this divergence comes from. What also emerges from the study is that some teachers construe the incorporation of the everyday in mathematics as the means to an end rather than an end in itself. Teachers who regarded the everyday as a vehicle towards mathematics viewed the role of the everyday in the mathematics class as such, and teachers who viewed the everyday as warranting discussion for its own sake in a mathematics classroom also viewed the role of the everyday as such. For example, teacher Kafule's style of lesson presentation displays this character because a number of times, the everyday was discussed for its own sake. There was indeed some resonance between the nature of the everyday recruited in his lessons and his perspectives on the role of the everyday. In addition, the recruitment of clearly non-authentic contexts suggests the perspective that the everyday is a means to a mathematical end. The use of the everyday which recruited contexts that appeared more authentic by including more detail and local information suggests a perception that the everyday in the mathematics classroom is an aspect which may be discussed in the classroom for its own sake.

The analysis of lessons as shown in Table 8 suggests that the public domain dominated teacher presentation of lessons. It is no surprise that the myth of participation is predominant in both teacher interpretations and in their lesson presentations. The predominance of the public domain and the myth of participation can possibly be explained by the fact that as a school subject, mathematics is mostly perceived as a difficult and uninteresting subject. Based on this assumption, educators tend to think that one way to help students to learn mathematics is through the myth of participation. As Boaler (1993, p. 13) stated, it is the attempt to bring about student motivation that results in the incorporation of realistic contexts not only in assessment questions but in classroom examples as well. While teachers might think that the solution for overcoming students' difficulties in mathematics is to make it look like they can do it by engaging them with what they know and can do already, students might rejoice over learning about what they already know. However, if teaching and learning are dominated by the public domain, this also raises a question of economy of teaching time if, for example, 15 minutes of the lesson is spent with versions of public domain activities. Dowling (1998) warned that while the public domain necessarily is an area where students are introduced to the esoteric domain of mathematics, the principles of mathematics cannot be realised here. These are some issues that mathematics teachers might need to be made aware of.

The analysis presented in Chapter 7 has highlighted issues that could add to the understanding of teacher practices of incorporating the everyday. When recruited task contexts were analysed, it emerged that tasks consist of components which the researcher called 'specifiers'. These include *protagonist(s), actions, aims, time or period, space* (place or location), and *conditions* (specifications or conditions for the action). This analysis suggests that the smaller the number of specifiers there are in the task contexts, the more generalised the task is, and the more it tends towards the myth of reference and the closer to the esoteric domain of mathematics. Jablonka (2002) made a similar observation in an analysis of textbook tasks. Dowling (1998, p. 16) asserted that whereas the 'myth of reference is to claim external motivation for mathematics', behind this myth lies mathematics as a 'self-referential' system. Hence, the task with fewer specifiers has a higher chance of introducing students to the esoteric domain of mathematics. It is not like the myth of participation which is realised through far more extensive reference to non-mathematical residues (task contexts with more specifiers in it). Contexts in the public domain texts exhibit a strong non-mathematical modality and they make extensive reference to a non-mathematical reality. Failure to do this would negate the claim of utilitarian function, which the myth of participation faithfully represents (Dowling, 1998, p. 16) and the objective it seeks to achieve.

The analysis presented in the penultimate chapter points to some pedagogic benefits. These specifiers can be useful in determining the extent to which the task is localised or not. To determine whether the task context is more localised or not, the setter of the task has to look at specifiers. For instance, a setter might ask: Who are the protagonists in these tasks? Are they mere domestic communal farmers, or are they from professional farmers such as those in commercial farming? To determine whether the task is generalised or not, the setter of the task has to ask how many specifiers are there in the task context. For example, the task '*Maria bakes 10 cakes for her daughter's birthday party guests'*, there are specifiers such as the protagonist (Maria), action (bakes), aim (for her daughter's birthday party), recontextualised activity (baking), and what was being baked is 10 cakes (object and its quantity). The analysis revealed that the more public domain specifiers in a task context, the more it tends towards the myth of participation.

Further, when the contexts, settings, and activities that teachers recruited are analysed, it became apparent that the sort of contexts teachers used are those from the immediate environment of the student rather than those that point to envisaged professional activities or wider social contexts. While this is in line with the teachers' commonsense about 'real-life' contexts, this analysis led to a conclusion that the message inherent in recruited contexts and settings suggests restrictions on students' professional identities (i.e. intended knowledge and future careers).

What emerged from teachers' discussions is that these mathematics teachers seemed not to differentiate between domestic activities and mathematics activities. As pointed out in the discussion of the myth of emancipation, which here means that mathematics is already part of the students' culture, they appear to think that these two are the same. For example, cooking porridge and making tea was construed by some teachers as mathematics activities rather than being as Dowling (1998) termed domestic activities. What can be drawn from this perception is that it appears that Dowling's notion of drawing on other practices would be useful for teachers. Further, it could make a difference if teachers understood the mythologising nature of their practices more, and they might profit from conceptualising and describing school mathematical activities in terms of domains of actions. Dowling's notion of a gaze cast on other activities could help teachers deal with the confusion which arises from conflating domains.

One way educators could start doing this is by reflecting on why mathematics is taught, as well as why incorporating the everyday is essential. Mathematics teachers might not only need to treat drawing on the everyday as a necessary tool to solve mathematics problems, but they should also look closely at what the recontextualisation process can do to the teaching and learning of mathematics. Teachers might need to be aware that the myth of reference speaks the 'voice of mathematics' and prioritises mathematics over other activities. This feature makes the myth of reference preferable to the other two, especially in assisting students to access the esoteric domain of mathematics. As this might run counter to conventional wisdom, differences between mathematical modelling for the sake of developing problem-solving skills and other forms of incorporating non-mathematical practices will need to be explained, and this has an implication for teacher education.

8.3 Other significant aspects

As already mentioned, another outcome emerging from this study was that the presence of a curriculum declamatory statement in the syllabus makes no difference to some teachers. In some cases, teachers do not even consider the statement. While those factors might look trivial, some of them should not be overlooked. Specifically, what can be learnt from the example of Ms Helao (interviewed and observed teacher), who felt that even if the statement required them to bridge mathematics and the everyday in their classrooms, the system itself forces teachers to teach for the exams? This suggests there are pressures within the teaching environment that push teachers not to do what is required of them beyond the particular goal of this study.

Asking how teachers understood the purpose of fetching the everyday in mathematics classroom could be essential. Further research could ascertain whether teachers construe incorporating the everyday in a mathematics classroom as a means through which students learn mathematics or as an end in itself. Future research is needed to determine whether recruiting the everyday is a means to develop mathematics competency or whether establishing connections is a competency in itself. Research is needed to determine whether interpreting mathematics embedded in the everyday is a competency that teachers want to develop in their learners and whether teachers want their learners to possess this competency. How exactly such a competency can be interpreted is open to debate and further research, particularly how this would be realised in assessment.

Mathematics texts in Namibia, whether monologic or dialogic, point to different domains. Since school mathematics tests in Namibia often have realistic items, being able to deal with these sorts of problems needs to be treated as a competency in itself, and not just as a means. Hence, drawing on the everyday should be considered as a competency for students to develop. Students require this competency to allow them to deal with recontextualised problems, and discussing these issues could be useful to teachers.

As shown in Section 5.3.5.1, subject advisors suggested ideal ways of implementing the curriculum declamatory statement. Brainstorming questions included asking students*: What kind of animals do you have around here? How do you cook? Do you collect fruit?* For the teacher, these questions might constitute what an application of mathematics is. Concerning the ambiguity pointed out by Sloyer (1976b, p. 19) as to what actually constitutes application of mathematics, it is essential to look at this type of suggestion.

8.4 Contributions

8.4.1 Theoretical contribution

This study made use of Dowling's Domain of Action Scheme (DAS) to investigate teacher practices of bridging mathematics and the everyday in the classroom. It has made a theoretical contribution in such a way that it was able to show how Dowling's DAS scheme could be applied to dialogic texts interactively produced by teachers and students in classroom practice. This study made some extensions to Dowling's public and expressive domain. In terms of the expressive domain, this study divided the expressive domain into two subcategories*: the expressive domain of procedures,* which includes the application of *rules* and use of *mnemonics*, as well as *the expressive domain of metaphors* defined by Dowling (1998). In terms of the public domain, the study uncovered that there exist other sorts of public domain texts that are eventually not looked at from the perspective of mathematics, and hence converge to some other discourse. These texts may have been recruited by teachers to engage students in mathematics lessons rather than facilitating student access to the esoteric domain of mathematics. This discussion is summarised in Figure 14.

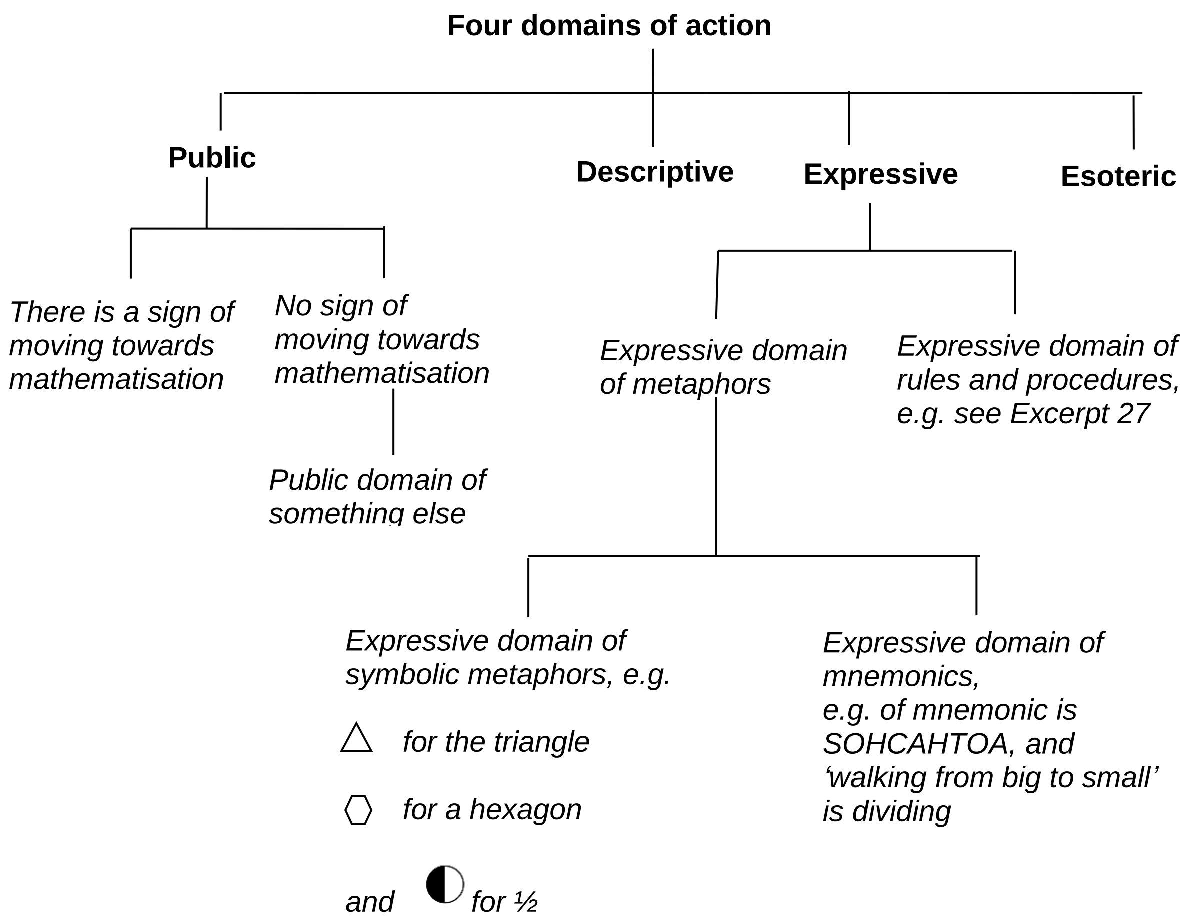


Figure 14: Extension to Dowling's public and expressive domains of action

8.4.2 Methodological contribution to enhanced understanding of education in Namibia

First, this study developed a methodology for describing what goes on in the classroom, particularly when teachers recruit the everyday in a mathematics classroom. This is a methodological contribution to the mathematics education research community. Through this method, it was possible to say something about myths in relation to actual classroom practice. In the analysis, one could see how these myths led to what happens in detail in the classroom, in particular, the differences in trajectories during lessons. A dominance of a myth of participation seemed to have led to teaching what is neither mathematics skills and knowledge nor any skills that might be useful in everyday life. One could label this as superficial mathematics teaching, particularly considering that this was also the case in grade 8, where the teaching of mathematics is supposed to be more advanced (see excerpts from Mr Kafula's lessons). There might be an issue here in terms of the quality of mathematics education.

This contribution is not only relevant to the Namibian context but also to the general field of practice. The Namibian examples offer informative illustrations of general issues. However, this is not to be taken as an offer to developing countries, as there is an international move towards this bridging of academic and the everyday, for example, in the PISA tests. Despite this move, however, there is still no clear understanding of the influence of the mythologising gaze as far as mathematics teaching and learning is concerned.

8.4.3 Pedagogical contribution

Relating mathematics to the students' everyday practices is a common goal across many curricula today, and it is an inevitable part of mathematics pedagogy as teachers work to enable the learning of this abstract science. This Namibian study will add substantially to understanding the pedagogic practice of bridging mathematics and the everyday more widely. As this analysis shows, drawing on the everyday in a mathematics classroom (or rather the realisation of the declamatory statement in practice) is not trivial, and often it comes with unintended consequences. This study investigated this subject in innovative ways. It is based on an extended review of the literature and has drawn on sophisticated tools. Concerning drawing on the everyday in teaching mathematics, the analysis of classroom video data has shown the complexity of the teachers' work. Part of the analysis pointed to issues of interpretation of curriculum mandates. This feeds back not only to knowledge and understanding of practice but also to some extent to policy.

As a recommendation, the claims made about some tendencies in the teachers' practice cannot be generalised to other schools. If the study is to inform the majority of schools, a survey of a representative sample of Namibian mathematics teachers could be administered in order to gain a broader picture of the situation in schools. The results of such a survey may be used to complement the data that has already been collected.

8.5 The study as a journey and personal experience

Conducting research is a personal endeavour and, in addition to its potential social benefits, is worth doing for its direct recompense to one's own self-realisation (Bullough & Pinnegar, 2001). As a mathematics teacher, this research has not only changed the researcher's perspective regarding what she thought she knew about the idea of incorporating 'context' but has also made her realise the need for continuous reflection on what she does as a teacher, as well as on what she still needs to know about this subject. The researcher's investigation has not only taught her more about what other Namibian teachers normally do as they bring the everyday and the mathematics together, but it has also opened up new avenues for critically looking at what it is that she claims to know and so created awareness regarding pedagogical aspects that either limit or enhance her professional practice.

Before developing the idea for this study, the researcher thought that incorporating the everyday into the mathematics classroom is a straightforward pedagogical tactic. In particular, she did not know that studies investigating the relationship between the academic and the everyday in and outside the mathematics classroom made use of the term ‘context’ and that there is a plethora of meanings that this term adopts. She had never thought that ‘contexts’ used in mathematics education can be classified in different ways. For example, she was not aware that there can be types of contexts which bear little or no relation to the mathematics being taught.

Further, the researcher had not considered that a context can be characterised by the extent to which students share it. Her choice of contexts was done based on what she intuitively felt was best, and she had never had reference points against which to judge the usefulness and productivity of the recruited context, be it as a metaphorical explanation, starting point for developing a mathematical procedure or structure, or a phenomenon of interest exposed to mathematisaton. Nevertheless, now she has come to realise that it is necessary and helpful for teachers to look at the ‘context’s’ forms of expression as well as its contents. With regard to the researcher’s own practice of recruiting the everyday in developing the mathematics, she never took into consideration the need to carefully choose the signifiers. Choosing non-mathematical signifiers for expressing mathematical concepts and structures (‘expressive domain text’) may be challenging, and one may not be able to find useful expressions. Constructing a ‘public domain’, while necessary, is not easy either. In this research, the fine-grained lesson analysis helped to reveal these difficulties, as for example in one teacher’s struggle with finding a signifier for the mathematical concept of area.

The researcher has also come to see that different positions may possibly inform the idea of incorporating the everyday into the mathematics classroom. These positions may not only elaborate the cultural, social and political dimension of mathematics but also of mathematics education, such as done by critical mathematics education and ethnomathematics. Hence, it is not possible anymore to ignore these dimensions when attempting to incorporate everyday practices and discourses into mathematics teaching. Usually, when the researcher taught mathematics, she never considered the hierarchies that exist between applied and pure mathematics, and that the esoteric domain of formal theoretical parts of written mathematics is valued more in tertiary mathematics education than in other more practical or applied fields. These are some of the aspects that lead to curriculum mismatch between secondary and tertiary mathematics.

Apart from the potentials associated with the idea of incorporating the everyday into the mathematics classroom, such as increasing student motivation, facilitation of meaning-making, and providing a life-like experience, the researcher learnt in this research journey about limitations and tensions associated with the idea. For example, she had never taken into account that students might have different perceptions regarding the ‘realness’ of everyday contexts, that they might assume the irrelevance of everyday knowledge, and that contexts might evoke sensitive experiences and alienate some students. It never crossed the researcher’s mind that unfamiliar contexts can be problematic and that they have a possibility of frustrating students. Additionally, she could not imagine that familiarity with the context can be a barrier to students’ learning as well because often familiar contexts can distract from the development of mathematical concepts. The analysis of the lessons revealed that as some mathematics teachers recruit the everyday in the mathematics classroom, they bring in other types of public domains other than the public domain of mathematics.

The researcher has also learnt that some of the curriculum contents understood in the field of production may not be understood in the field of enactment. Consequently, there can be several interpretations that could affect the curriculum implementation process. It is surprising that what teachers do in the mathematics classroom may not necessarily be influenced by the demands of the curriculum, yet mathematics teachers might act in the ways they do because they deem it necessary for students’ learning. This is what happens to the idea of linking mathematics and the everyday in the mathematics curriculum as stated in the declamatory statement.

Through examining the teachers’ and subject advisors’ views, the researcher has come to appreciate the significance of the ‘myths’ identified by Dowling. In this context, she has also learnt that the type of contexts recruited could suggest particular professional identities for students (reference here can be made to Figure 11). It turned out to be a promising avenue to have a closer look at ‘localising’, which the researcher referred to as the attempt of framing task contexts within the students’ local environment. This is normally done with the purpose of creating meaning, engagement, and motivation for the learners. The analysis revealed that in each task, there are various specifying elements, and the more specifying elements there are in the way the task context is framed, the closer it gets to the everyday.

Conversely, the fewer specifiers there are, the closer it gets to the esoteric domain of mathematics.

Overall, this research contributed significantly not only to the researcher's professional growth but to her personal growth as well. This journey did not only engage her in critical reflexivity regarding what she does as a mathematics teacher but also engaged her in pedagogical thoughtfulness. This journey made her realise that her future success as a teacher in a mathematics class does not only depend on exposing issues that may hinge on her professional practices but also on confronting them. As new aspects arise in mathematics education, the researcher keeps on contemplating how she can consolidate her future teaching practice.

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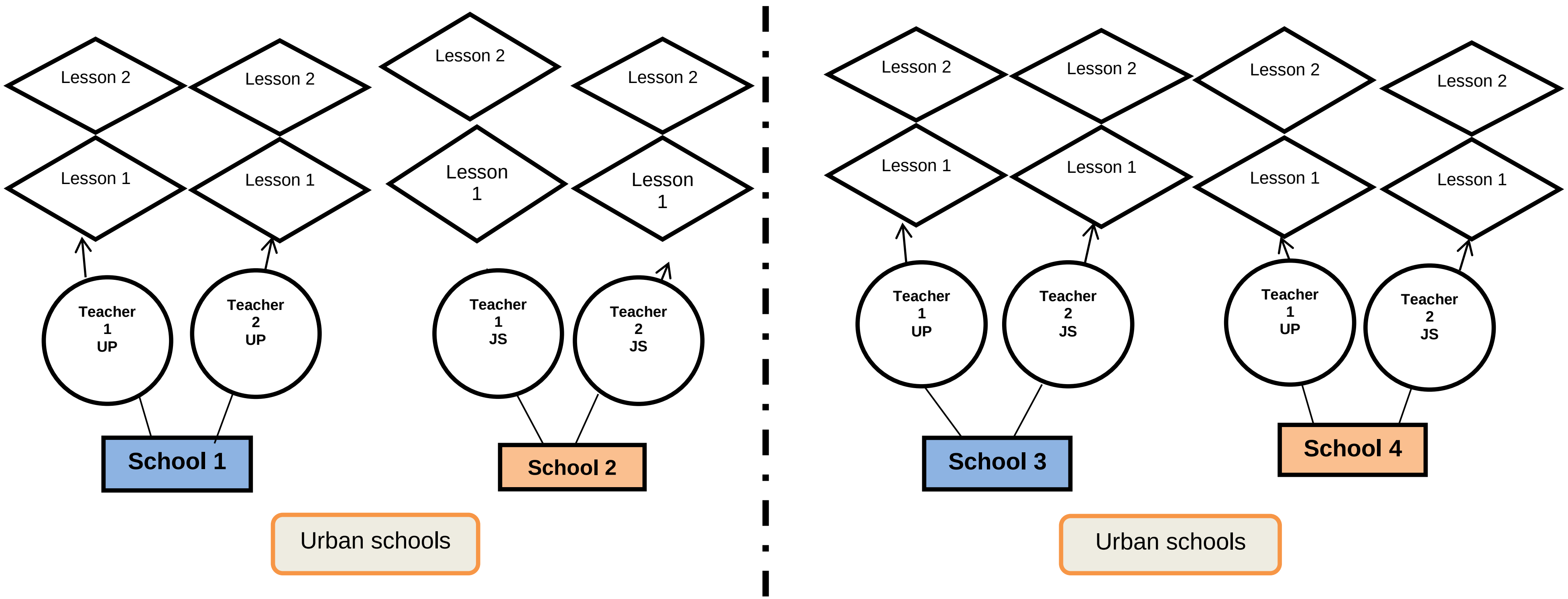
APPENDICES

Appendix 1: Observation plan



KEY: School 1 = Primary school (*i.e. has Grade 1-7*), **School 2**= Junior secondary (*i.e. has Grade 8-10*), **School 3** and **School 4** are Combined schools (*i.e. have Grade 1-10*). **UP** = Upper Primary Mathematics teacher and **JS** = Junior Secondary Mathematics teacher

Appendix 2: Pre-observation interview questions for teachers of mathematics

I am about to observe your coming lesson, and this interview session is basically to prepare me for what is coming.

1. What should I be looking forward to in your coming lesson?
2. How do you like this subject/idea of linking mathematics and the everyday being part of the syllabus and what you do?
3. How do you understand the statement ‘linking mathematics & everyday life/everyday situations? What does it mean to you?
4. What is everyday life to you?

Appendix 3: Individual interview questions for non-observed teachers of mathematics

Introduction: What grade(s) are you teaching, and for how long have you been teaching mathematics?

Someone wrote this statement in the syllabi for both Upper Primary and Junior Secondary. A statement from the syllabi reads: *Mathematics is a universal language; it is only by local contextualisation and application that younger learners will understand and appreciate the uses of mathematics.*

5. What sense do you make out of this statement. (What does this statement mean to you?)
6. Let us take them one by one. What is meant by:
    i. ‘Mathematics is a universal language’
    ii. ‘Application’
    iii. ‘Local contextualisation’
7. What do you think are the reasons why this statement / terms introduced/ included in the syllabus? What do you think sparked its inclusion?
8. Do you share this statement? (Do you agree with it?)

9. How does this statement/concepts affect you as a mathematics teacher?

10. Some people say this is a curriculum goal, others say it is something else. What do you say this is, and why?
11. How would you advise a novice teacher or a foreigner who has come to teach at your school, as to what they need to do in order to adopt this particular statement in their teaching?

Appendix 4: Post-observation interviews questions

The nature of questions for the post-observation interview will be highly determined by the lessons observed that day. Basically, they will centre on the following three aspects:

1. What do you think of your lesson presentation today?
    - What / how would you do it different from what you did today?
2. Could you please help me identify specific area of the lesson that you think bridged/linked mathematics and everyday life?
3. May I ask you to clarify some of the aspects that took place during the lesson?
4. In your opinion, since the day the concepts of application and contextualisation became part of the syllabus, what significant changes have you noticed (be it in teaching, textbooks, or exams)?
    - What do you think about the changes you have identified?

Appendix 5: Interview questions for subject advisors

1. May I ask you to introduce yourself, mentioning the portfolio you hold, and your roles as administrator?
2. Who are the parties to the design and development of the mathematics syllabi?

3. Someone wrote this statement in the syllabi for both Upper Primary and Junior Secondary. It reads: *Mathematics is a universal language; it is only by local contextualisation and application that younger learners will understand and appreciate the uses of mathematics*. what is meant by:
    i. 'Mathematics is a universal language'
    ii. 'Application'
    iii. 'Local contextualisation'

4. Why is this statement part of the curriculum? / What were the reasons for introducing this statement in the syllabus? What might have sparked its inclusion?
    - Do you share this statement (agree with it)?

5. What bearing does this statement have on mathematics teachers in the field?
6. How are teachers expected to put this statement into practice?
7. Are there instructional guidelines for putting this statement into practice? What are they?
8. Some people say this statement is a curriculum goal, others say it's something else, what do you say this is?
9. Suppose a novice teacher, or a foreigner who came from a different country, came to you for some tips on how to deal with the statement, how to would you advise them?
10. What significant development or changes have you noticed since these concepts were made part of the mathematics curriculum?
    - What can you say about these changes?
    - What has been positive about these changes?

Appendix 6: Grade 8 mathematics lesson

Setting stage	0000	**0058**	**T:** (( )) you just miss it?	**Episode 1**:
Didac (Dima) Func	**Time**	58se per episode/theme	**Lesson Content**	**Remark**
				Interpretation1: Teacher introduces the **topic** ‘measurement’ and narrow down the theme through a question for a particular student about how far it is from school to her home; including units of measurement in the question. Teacher asks Becky who says she didn’t measure. This question suggests that the legitimate answer would be agreement about the importance of measurement. Could this be public domain? In Dowling’s scheme ‘public domain’ means that the whole thing amounts to a mathematisation. Asking these questions by the teacher “how many *kilometres* from your home to school” and “how do you know” and answering by the student “It is may be one kilometre”; “I am not sure because I did not measure it.” can be taken as a sign that this conversation is moving towards mathematics. **Mathematisation** refers to a process in which something is being rendered more mathematical than it has been before (Jablonka & Gellert, 2007, p. 1). **Link version**: ***Preface and the incorporation of immediate and non-immediate contexts.*** (This name came from the function as well as the ‘distance’ of context to which it refers.) **Topic** : Measurement Theme1: **Distance** travelled from home to school.
			Ss: No	
			T: Yaah people… measurement… measurements… measurements is used in many cases. ((But only this one we are ready to doing it… isn’t?))	
			Ss: Yes)	
			T: Eee?	
			SS: Yes	
	0007		**T:** ((We are ready to do it.)) **Now pay attention please**. Do not worry… pay attention. Iyaa. So… for example- Becky**… how many metres or kilometres are from your** home **up to this school?** (0.03) Eee?	
			Becky: I think is-	
			T: Ee?	
			Becky: It is may be one kilometre and-	
			T: How do you know?	
			Becky: I am not sure because I did not measure it.	
			T: You did not measure it? Ok thank you.	
			Becky: But just by estimating.	
			T: By estimating?	
			Becky: Yah.	

				Type of Settings employed**:** <u>*home*</u> *&* <u>*school*</u>*.* ***Classification* of setting**: *Non-specialised.* <u>*Home*</u> *(unspecialised setting) &* <u>*school*</u> *(depending on the context, school might be viewed as specialised setting but here it is used in unspecialised way).* **Type of activity** employed**:** non-mathematical (<u>*Walking*</u>) **Classification of the activity**: *Non-specialised/weak classification*. **Classification of context**: non-mathematical/non-specialised <u>***Interpretation 2***</u>**:** This is **public domain.** T<u>here is only little bit specialised vocabulary of signifiers</u> (km and m). This is **public domain** and **not** just other weakly classified conversations, because the question. "How do you know (Why do you say so) and (I am not sure because I did not measure it.)" gives a feeling that this is going towards mathematics. Why <u>***Public***</u>? *Firstly*, because there is a <u>weak framing of the criteria</u>, this <u>implies weak classification</u>. *Secondly*, I cannot see mathematics coming in except little vocabulary of signifiers (km and metres). Hence, this talk employs a weakly classified ***mode of expression,*** and it is **weakly classified** because (1) it is characterised by the use of ordinary language and (2) the everyday non-mathematical context of walking is drawn in; and (3) there is a sign of a move toward mathematics. As it can be seen in the question "how many metres or kilometres are from your home up to this school?", the content or what is being referred to is non-

				mathematics (kilometres walked). Didactical functions: as a preface for introducing measurement.
		0127 27s	**T: Do you think it is very important to- to measure something?** public domain	**Episode 2**: The teacher requests justification and Becky produces justification through a hypothetical situation about giving advice to a person who wants to reach the house. **Link version**: *Function in relations to new mathematics knowledge. Teachers do make some links as a prelude or preface to mathematics teaching/knowledge. In this episode, another function this episode seems to serve is that of developing cultural identity.* **Topic**: M*easurement* **Theme**: *importance of measurement*. Discussion shifted from measurement to the importance of measurement. Other public or public of something else **Type of Activity** employed: **Directing** a person to *a* **house.** **Classification of activity**: weakly specialised. **Classification of context**: non-mathematical or non-specialised **Type of Setting** employed**:** *house.* ***Classification of setting****:* weakly specialised / institutionalised. ***Interpretation:*** Teacher challenges the justification by the student through giving a sensible alternative. Students evaluate the alternative as appropriate. Unclear what the
			Ss: Yes	
			T: Why?	
	0106		**Becky**: It may be that someone- **you want to direct a person to your house** but you don't know how to direct that person. By telling the person that there is how many **kilometres** to your house… so you have to tell them there is may be two kilometres to the house and you do not measure. That is why you have to measure it to find how many kilometres are there.	
		0148	**T**: Ok. **What about if you tell the person that- ah from here up to your house is only three houses? Is that fine**? Other **public domain**	
			Ss: Yes	
			T: Yes? Why?	
			Ss: Because-	
			T: Ee?	
	0151		**Sekupe**: Because you just count the houses.	
			T: You just count the houses?	

				legitimate answer would be, ironically, the teacher's question might be prompting a re-evaluation of the alternative. The type of conversation appears to be pedagogic in that in teaching we ask students to justify their answers. **Domain: <u>Interpretation</u>:** Is this **<u>public</u>** <u>domain</u>? Dowling applied his scheme only to tasks and I am applying mine to a conversation (*classroom interaction*). <u>In Dowling's scheme 'public domain' means that the whole thing amounts to a</u> **<u>mathematisation</u>**<u>.</u> But in the episode (*conversation*) here <u>no direction towards mathematisation is visible</u> and no 'teaching' about anything either. '<u>Teaching' would be visible when the teacher clearly possesses the criteria for evaluating what students say</u>, and this does not seem to be the case here. It appears as if it is the students who can evaluate appropriateness of suggestions. Alternatively, I could also be the case that the teacher is doing this deliberatively. Possibly, the teacher is presenting the students with an alternative to make them reflect on their previous answers. Hence, one could say this is a **deliberate pedagogic strategy**. *Secondly*, this conversation can be interpreted in terms of *<u>classification</u>*. Apart from differentiating *classification* of this conversation in terms of '**distance of context' to which it refers** (as in episode 1), alternatively, *classification* can also be **differentiated in terms of <u>specialisation of context</u>**. A <u>specialised context</u> could also be taken from: (**1**) *mathematics as a subject or field of study* (e.g. mathematical and non-mathematical contexts / weakly or strongly specialised/classified); or from (**2**) a *<u>professional practice</u>*. From a <u>professional practice</u>, I mean one could of course still

				differentiate further, for example between low-skilled manual, skilled crafts (carpenter) and academic professions. Here the context is not specialised (telling a person how far away your house is), neither is the form of expression. Overall, this episode seems to be about relating a more formal measure (km) to a less formal measure (houses) (1) Though this conversation is weakly specialised/classified (2) and the posed question is seemingly a task; it does satisfy Dowling's **public** domain on one hand. But on the other hand, this talk **is not about teaching** and there is no sign of mathematisation. In this case, it does not fully fit in with the current Dowling's public domain. Other **public domain.** **Classification of everyday**: immediate (i.e. from here to your house)
Introd/ developing new knowledge (2)	0153	**0228** 1m3s	**T** proceeds: So people measurement is very… *very* important in life. Iyaa… not only in our days. **Traditionally we used to do this one**. You know those um- these aam- rural areas?	**Episode 3**: Topic: *Measurement* **Theme**: *Traditional measures: Directing a person* **Mode of expression**: weak classification **Classification of context**: non-mathematical /non-specialised **Type of Activity** employed**:** Directing a person in a village. **Classification of activity**: Weakly specialised/ Non-maths activity. **Type of Setting** employed**:** Okafaila (*a shack or cottage).* **Classification of setting**: Weakly specialised **Classification of everyday**: immediate Interaction: **TtS** = teacher telling a story. **Domain**: Not looked under the gaze of maths - other **public domain + move 2 maths.** Again, here the context is not specialised (directing a person how far away your house is), neither is the form of expression. Since the traditional context isn't about any profession or vocation, then perhaps I should think about the *function* of the traditional context in relation to goals of general education: that of **developing cultural identity**.
			S: mmh	
	0200		**T**: How do they direct a person? You go this one you will find okafaila (*a shack or cottage*). You go like that one you will find a tree there. Iyaa… after that one you will also find another tree there then you will reach the place. If you go there my friend… it can even take you half of the day. It is far. But… if you say ok from here to here is this **kilometres** at least you will know the distance… isn't?	
			Ss: Yes	
			T: Eee? That is why it is always very important you measure the distance for the length.	

				Link version: *Teacher locates mathematical ideas for discussion from non-mathematics contexts by referring to traditional way of doing things.* **Interaction: Tac**
		0251	**T:** (*proceeds*)**:** Ok. Even in the **shop** there- do you just **go there in a shop and say ok you take this one.** If you are given this one will you fit in?	**Episode 4:** Topic: I*Importance of measuring distance or length.* Theme: Shopping and trying on / fitting in shoes **Link version**: *Referring to contemporary way of doing things.* **Domain:** Not looked under the gaze of maths therefore it is other type of **public domain** **Classification of Context**: non-specialised/non-mathematical **Classification of everyday**: immediate **Type of Activity** employed**:** shopping & fitting in shoes, traditional, historical &near (Sethole, 2004), **Classification of activity**: unspecialised/ weak classification **Type of setting employed**: a shop **Classification of setting**: unspecialised/ weak classification
			Ss: No	
	0238		**T**: Why?	
			Ss: Because we do not measure.	
			T: What about the shoes?	
			S: Ee?	
			T: Shoes. Can you fit in my shoes?	
			Ss: No	
			T: Why?	
			S: Because we are not the same.	
	0250		**T:** Because we are not the same…isn't?	
			Ss: Yes	
	0300	**0317** 25s	**T**: Ok. So people it **is always important to take measurement**. **You know that long time ne**. Those people… the elder ones. Ope na ou e shii ombadu yekaya? (*Does anyone of you know Ombadu yekaya?)* *Ombadu yekaya is a measure of tobacco, usually in a ball-shape. Normally this tobacco is smoked by elders on pipes such as the one below:* ) *Teachers ask students if any of them know such a measure of tobacco*	**Episode 5:** Topic: I*mportance of taking measurement* **Theme**: Determining student awareness of *Ombadu yekaya.* **Type of context**: non-specialised/non-mathematical **Mode of expression**: weak classification **Type of Activity** employed**:** Measuring Ombadu *yekaya*. **Classification of activity**: unspecialised/ weak classification **Type of Setting**: Setting is **not specified** as to where - therefore **generalised**. **Classification of setting**: the context of the problem suggests unspecialised setting. **Domain**: Not looked under the gaze of maths therefore it is other type of **public domain** **Classification of everyday**: immediate Myth of reference: **Type of conversation**: *Exchange relation?* **Link version 1**: *Teacher draws on historical events to in order to contextualise teaching*.
			S: Ee? (What?)	
			T: Ekaya linya kwali ha li hilwa nale kaakulunhu? (*The tobacco that elders used to smoke?*	
			Ss: Eehe (*yes*)	
			T: Ope na ou e li shii? *(Anyone familiar with it?*	
			Ss: Eee (yes)	
	0313		**T:** Linya kwali ha li yandjwa peehango nale mOshikwanyama? (The one that is usually given during marriages in Oshikwanyama?) Eee? That tobacco. The one of this size.	
			Ss: Eee (Yes)	

			T: Do you know that one?	**Link version 2:** *The teacher code switches or reaches to local language*. **Interaction**: Tac
			Ss: Yes	
			T: Eee?	
			Ss: Eee	
		0416 1m0s	**T**: **So people… you nowadays are using measurements. Do you know what those people use to do?** If someone comes to you and ask you tobacco. Do you know what this a cu- person will say? Go to that and bring some tobaccos. **Do you know the meaning of this one? Look at me.** *The teacher put his thumb and index figure together to demonstrate the measure to students.*	**Episode 6**: **Topic**: I*mportance of measurement* **Theme**: Measuring *Ombadu yekaya.* **Type of context**: non-specialised/non-mathematical **Mode of expression**: weak classification **Link version 1**: *Teacher draws on traditional measure to contextualise teaching*. **Link version 2:** *The teacher code switches or reaches to local language*. **Type of activity:** measuring Ombadu. **Classification of activity**: unspecialised/ weak classification **Type of Setting**: **not specified**, therefore **generalised**. *Unspecified* setting amount to **weak classification** **Domain**: Other type of public - it is not looked under the gaze of maths. This is **public domain** and probably other weakly classified conversations, because the question. "**T**: Do you know the meaning of this one? Look at me. What does this mean? **Sos:** Centimetre… little)" gives a feeling that this is not necessarily going towards mathematics. However, while some students suspect that the sign the teacher is making means '***a little***', other student feel it means '**a *centimetre***'. Again, the **Pedagogy** is a **weak pedagogy** or **weakly framed** because the legitimate criteria is not evident, and therefore students can answer this question in any way they see it appropriate as they tried to do (little, just a little, centimetre). This also *makes it look like* **public domain** because of this **weakly framing of criteria.** Because I cannot see any other mathematics coming in apart from a weakly specialised vocabulary of signifier (centimetre). **Classification of everyday**: *non-immediate*, but it can still be taken as *immediate* if it is still practised. **Interaction**: Tts
			S: Yes	
			T: What does this mean?	
			S: Little.	
			T: Eee?	
			Sos: Centimetre… little	
			T: What?	
			S: Little… just a little?	
			T: Jus a what?	
			Sos: A little	
			T: Of this size. Iyaah. Just a little so that a person who is sent does not know whether it is much or few. Kotokeni can you please **go to the *room*** and bring what- for us some tobacco? You go there to bring tobacco then you measure it- then you cut. If you bring the big one you will be beaten. I am telling you.	
			Ch: [Laughter]	
			T: Oto dengwa filu filu. Shama ashike wa eta ko ombadu aishe. O u na okudengwa. Ta ku ti wa apa ngoo pe kwetiwe apa opo nee ometifa yee. (*You will be bitten if you bring a whole lot of tobacco. That means the measure on the two fingers implies the measure or the amount of you have to bring*.)	
	0414		**Ss**: Ee.(*Okay*)	
			T: So **measurements** came very long time ago and are very… very **important**.	
Review (3)		**0526**	**T** (*continues*): Ok. Fine. Let's now look to this. We have like a *length*… isn't? (0.03) instrument… units. *Teacher writes on the chalkboard as he recites these words.*	**Episode 7** **Topic**: *Length.* **Theme 1**: *Defining concept length*

		1m10s	[Pause]. Ok. **Everyone knows what a length… isn't**?	**Mode of expression:** weak classification **Type of context:** mathematical - Defining a mathematics concept of *length,* and listing or naming the instrument of measuring *length* implies a mathematical context. **Type of settings** employed**:** *towns, classroom, and toilet.* **Classification of setting**: unspecialised/ weak classification **Used specialised vocabulary**: *length*, *Centimetre*, *Kilometre*, *ruler*, *measuring tape*. **Used non-specialised vocabulary**: palm leaves (eembale), ropes, Strings or threads **Classification of everyday**: *immediate* -The teacher defines the concept **length** by using **closer** places that are within the school. **Domain**: *public* – apart from the definition of concept *length*, the mathematics gaze is not that evident. The mode of expression is weakly specialised. Judging from the question (Everyone knows what a length… isn't?), the **Pedagogy** begins in a **weak pedagogy** or in **weakly framed** fashion, with the teacher assuming that "everybody knows what length is". Then the pedagogy shifted to a strong pedagogy or strongly framed fashion where the teacher started to explain or give the definition of a concept length. This *makes it look like* **public domain** because of this **weakly framing of criteria**
	0500		**Ss**: Yes	
			Ben: No	
			T: Eee?	
			Ss: Yes	
			T: A length is a what- **how long a particular thing is** or **a distance between two or more points**… hasho (isn't)? Or **a distance between towns or two towns or two places.** Or the **distance between your class and the tuck-shop**… or **your class and the toilet**… isn't?	
			Ss: Yes	
			T: Eee?	
			Ss: Yes	
		0535	**T**: Ok. Which **instruments do we use whenever we are measuring length?** Yes.	**Theme 2**: Naming instrument of measuring **length** ***Type of* Context**: mathematical but weakly specialised because of the use of specialised vocabulary. **Domain**: public- because of weakly classified mode of expression. In addition to the definition of concept *length*, I cannot see any other mathematics coming in apart from a specialised vocabulary of signifier (length, centimetre) mention by the student who seemed not to be aware of the difference between an instrument and the unit of measure. **Setting**: none
		10s	**Shetu**: Centimetre	
			Toini: M mh… M mh … Oh.	
		0601	**T:** Ok… let me ask. Ok. Eeh… **what is an instrument?**	**Theme 3**: Defining an instrument Teacher restate or rephrase the question from ('Which **instruments** do we use whenever we are measuring length? **to '**what is an instrument?'). the mode of expression is still weakly classified. Some student still appear not to be aware of the answer. The teacher tries to clarify his question by differentiating between 'an example and the thing'. **Context**: non-mathematical/non-specialised **Domain**: public- because of weakly classified mode of expression. **Setting**: none Interaction: **Tac**
			Toini: Instrument-	
		26s	**Mark**: Can you state?	
			Toini: Oh… Yesses.	
			T: What is an instrument?	
	0550		**Peter**: Instrumenta?	
			T: Ehe (yes).	
			Peter : These are--	
			T: There is a difference between an example and the thing.	
			Peter: These are objects that we use when we are measuring things.	
			T: Very good. Objects we are using when we are measuring something.	
	0600	**0656**	**T** (proceeds): **For the length… which instruments do we use?** Where are the people… yes.	**Theme 4**: Naming instrument of measuring Length **Domain**: Although there is a vocabulary of specialised signifiers coming in (km, ruler, measuring tape -*brought in by students*) and the discussion seems to move towards mathematisation, the domain is still public- because of weakly classified mode of expression. Yet this also seems to be a weak pedagogy as the *legitimate*
			Lydia: Kilometre.	
		55s	**T**: Eee?	
			Lidia: Kilometre.	

				/evaluative criteria appears to lie with students- **weak framing**. **Context**: is still non-mathematical/non-specialised

			Martha: Oh you… that is a unit.	
			Sem: Sir measuring tape	
			T: Eeeee… eh.	
			Sem: Unit	
			T: [Laugh]	
			Erkie: A ruler…. we use a ruler.	
			T: Ok… we can use a ruler. Aha, what else?	
			Erkie: (( ))	
			T: Eee? What else? Eee?	
	0630		**Saima**: Tape	
			T: Eee?	
			Saima: The tape	
			T: The tape. Do we just say tape or what? Aha.	
			Soini: We say a measuring tape	
			T: Yaah… we have a measuring tape. Ehe…	
		0814	**T** (*proceeds*)**:** what else? What else? Oh… people what else? **Becky** what else? I want something **traditional**. What do you use? Eee?	**Theme 5**: Listing **traditional** instruments of measuring Length ***<u>Interpretation</u>***: teacher shift from asking about the conventional instruments of measure to the traditional instruments of measure. **Context**: non-mathematical and weakly specialised because of the use of non-specialised vocabulary. **Domain**: public- because of weakly classified mode of expression. <u>I cannot see any other mathematics coming in</u> and no <u>specialised vocabulary of signifier is evident.</u> Then the pedagogy shifted to a strong pedagogy, or ***strongly framed*** fashion where the teacher dictates the evaluative criteria (i.e. the type of measures students should give- traditional ones). **Setting**: none
			Touno: Traditional?	
	0720	1m18s	**T**: Eee? Aaaye (No)… what else? Camon… camon… hurry up. Time is running.	
			Touno: Eembale (Palm leaves).	
			T: Eee… What?	
			Touno: Eembale	
			Mark: [Laugh]	
			T: What? Hurry up.	
			Touno: Eembale (Palm leaves)	
			T: What? What do you say?	
			Touno: Eembale (Palm leaves)	
			T: Eembale? (Palm leaves?)	
			Ss: [Laughter]	
	0735		**T**: Do we really use that one?	
			Sos: Yes… No	

			T: Eee?	
			Ernie: No	
			Hango: Rope	
			T: Yaah… we use also ropes.	
			Sem: No… not ropes.	
			T: Mmh?	
			Sem: Threads. Strings or threads	
			T: What?	
			Sem: Strings or threads. Not ropes.	
			T: Not ropes?	
			S: Yes	
			Sem: Ropes are big.	
			T: Ropes are bigger?	
			Ss: Yes	
			Sem: They are the one to pull the cars.	
			T: What about the small one? Is not that a rope?	
			Sem: That is a thread or string.	
			T: Ohoo… Only a thread like that one for physical science? Only a thread or?	
			Sem: A string	
			T: A string?	
			Sem: Yah	
Introd, Sharing & Develo ping Knew knowle dge (3)	0755	**0955** 1m41s	**T**: Ok. People before we mention the units. As I said that measurement started long... long time ago. Like elders they use threads… strings… or even ropes. You know how?	**Episode 8**: **Topic**: Importance of knowing how to take measurement **Theme**: Buying a beautiful ring **Mode of expression**: weakly classified. **Type of context**: non-mathematical- **Type of Activity**: Buying a beautiful ring – in a trial & error fashion. **Domain**: Public because of weakly classified mode of expression. Other type of public domain because it is not looked from the perspective of mathematics. **Classification of everyday**: non-immediate. Link version = Utilisation of made up or make belief stories or examples. Interaction: **Tts** Teacher use assumed example of everyday (Make-belief example of everyday) in making links. **Function** in relation to new maths knowledge = perhaps to motivate or to engage learners.
			Penny: No	
			T: Eee?	
			Ss: No	
			T: Let me give you a very good example. **Like you when you were growing up ne**. That time ne- You know… people used to get married. But the problem that time those people of long time they don't know how to read and write. Now think about um the person who what to buy aam what- her wife a beautiful ring. A person who does not know any- any units of measurement. What do you think those people used to do?	
			Ss: [Silence]	
			T: What do you think they used to do?	
			Shetu: Use a thread.	
	0912		**T**: How?	

			Shetu: To measure the finger.	**Interaction**: Tac Didactical function: the teacher tries to or the 'harnessing' of out-of-school activities for the learning of school Subjects.
			T: To do what?	
			Shetu: To measure the finger. You put a thread on the finger.	
			T: You put a thread on the finger?	
			Shetu: Then you take the size	
			T: Then you take the size… then you go to Windhoek. You go in the shops… you take this ring one by one… you measure it… isn't?	
			Shetu: : Yes	
			T: Eee?	
			Ss: Yes	
			T: Ah… this one is big. And then you go the other one and you measure it.	
			Ss: It is small.	
			T: It is small. Till you get the exact one. Because that time things were scarce. Ka kwa li kuna nee transport kaya. Okwa li da pumba neenghono… hasho? (*There were no transports. They were very scarce*… isn't?)	
	0947		**Letu**: Except to my family.	
			T: Osho naa na shali ngaho. Ndee ta mete naanaa okalinga ndee ta eta naana okalinga ka wana ngaashi ke li. (*That is the way it was. He measures them and he would bring an exact ring as it is*). **That is why it is very… very important to know how to take measurement**.	
	1000	**1032** 37s	**T** (*proceeds*): Even people when they are *making their* ***traditional houses***… how they do it?	**Episode 9**: **Topic**: measurement **Theme**: Importance of knowing how to take measurement: Making (*building*) traditional houses. **Mode of expression**: weakly classified. **Context**: Non-mathematical/non-specialised **Type of activity** employed: Building traditional **houses** **Classification of activity**: Weakly specialised/classified **Type of setting** employed: Traditional **houses** **Classification of setting**: Weakly specialised/classified **Classification of everyday**: Immediate **Domain**: Public- other type of **public** domain- not looked from the perspective of maths. **Interaction**: Wd **Link version 1**: *Teacher draws on traditional measure to contextualise teaching*.
			T: Eee?	
			Nekoto: They use-	
			T: Before… they use what?	
			Nekoto : ((Rope))	
			T: The other instrument is what? Traditionally is what? Feet.	
			Tim: Oo… yaah.	
			T: Isn't?	
			Tim: Yah	
			T: They start drawing what?	
			Tuyoleni: Lines	
			T: Eee?	
			Ss: Lines	
	1020		**T**: Lines using what? Then they call an elder person inside the hut and start drawing the house using feet. **That is why** people **you suppose to know the measurement**.	

	1034	**1142**	**Peter** : Sir	**Episode 10**: **Topic**: measurement **Theme**: Measuring or counting kilometres with a Car instrument **Example**: *Learner-initiated example*. **Mode of expression**: weakly classified. **Type of Context**: non-mathematical **Type of activity**: measuring distance (km) with **car instrument** (speedometer) **Setting/object**: car **Classification of everyday**: Immediate **Specialised vocabulary of signifiers**: kilometres **Domain**: <u>Public</u> –because its **Mode of expression** is weakly classified. The learner's statement which says "you know those numbers for **counting distances in kilometres**" suggests the move towards mathematics / a mathematics gaze. **Interaction**: **SiE** **Link version**: use of immediate contexts
			T: Yes	
			Peter: We can also measure something using a car.	
		1M10s	**T**: The what?	
			Peter : A car	
			T: A car?	
			Peter : Yes	
	1040		**T**: Oh… kaana ove… how? (Oh… you how?)	
			Peter: Inside the cars there are instruments that are used to measure kilometres. Whenever we are driving we use to check. There is something in- just that- you know those numbers for **counting distances in *kilometres***.	
			T: Mmh.	
	1104		**Peter:** Is where- May be if I give this person my car then I say just go to Oshakati Spar and bring my car back. If may be he went far away from Spar I can find out that because the **car is counting kilometres**.	
	1112		**T**: Ohoo… you mean when you like now -- When you want now to what- Let me say when you are sending someone somewhere there. It is easier when you are using a car?	
			Peter : Yes	
			T: You get a car… then you put all new kilometres… then you check how big is this one… isn't?	
			Ss: Yes	
			T: Eee?	
			Peter : Yes	
			T: How big is this place… isn't?	
			Peter : Mm.	
			T: Yah… it is true that nowadays you can use the car to set time… you know. Like when you are a **farmer** or what so ever it is always good to use a car to set a time.	
Revision (2)	1150	**1220**	**T** (proceeds): Ok. Fine. **What are the units now… units? The smallest unit in measurement is what**?	**Episode 11** **Topic**: measurement **Theme 1**: Naming the units of length **Mode of expression**: strongly classified/specialised. This conversation is clearly associated with mathematics. **Context**: mathematical= naming smallest units in measurement and listing units of
		38s	**Sem**: Millimetre	
			T: Eee?	
			Ss: Millimetre	
			T: Millimetres	
			Ss: Centimetres.	
			T: Centimetres. The other one?	

			Setson: Metres	length. **Domain**: Esoteric **Interaction**: Wd **Specialised vocabulary of signifiers**: metres, cm, km, tonnes and length. **Link version**: None
			T: Metres. The other one?	
			Setson: Kilometres	
			T: Kilometres. The other one?	
	1208		**Sem**: No	
			Maria: The tonnes	
			T: What?	
			Sos: No… tonnes.	
	1212		**T**: For the lengtha? Tons for the lengtha? [sic]	
			Sem: No	
			T: Aaye… be serious. Eee?	
			Soini: Hectares	
		1231	**T**: Like the farmers… **how do we measure the farms**? Do we use kilometres?	**Theme 2**: Measuring farms **Mode of expression =** weakly classified **Type of Context:** Non-mathematical **Type of activity** drawn in: Measuring farms **Type of Setting**: farms **Classification of activity:** Weakly specialised/classified. **Domain**: <u>public</u> because its **Mode of expression** is weakly classified, and it is looked under the gaze of maths. **Specialised vocabulary of signifiers**: Hectometres, Hectometres
			Ss: No	
		11s	**T**: We use what?	
			Ss: Hectometres	
			T: Not Hectometres but?	
			Shetu: Hectares.	
			T: Hectares.	
			Selma: hectres	
			Shetu: Yes	
Introd/ Sharing & developing new knowledge (9)	1300	**1312** 31s	**T**: **That is why people I say it is always very…** ***very*** **important to do what-measurement**. Like right now… eee… omapya kwinya ha ku limwa ota vixwa… hasho? (*Like now… farms where people cultivate are being measured… isn't*?) **Didn't you hear that story of what is happening in Omangeti area** there? Eee? Between some tribes? Ndongas want to chase Kwanyamas from Ndonga area because they said they took so big places unnecessary. Iyaa…they want them either leave the place or divide it.	**Episode 12:** **Topic**: Importance of doing measurement **Theme 1**: Measuring communal land and the consequence of tribal **conflicts**. **Type of Activity** drawn in: demarcating communal farms **Mode of expression**: Weakly classified/specialised. **Type of Context**: is non-mathematical **Type of activity drawn in:** measuring farmlands/ **tribal conflicts**. **Classification of activity:** Weakly institutionalised / classified **Type of setting** employed: **communal farms in Omangeti area** **Classification of setting**: Weakly specialised/ classified **Classification of everyday**: non-immediate- omangeti farms is some km away from school and surrounding villages. **Domain**: other types of Public domain- because its **Mode of expression** is weakly classified, and it is not looked under the gaze of maths. **Interaction**: Tts **Link version1**: drawing mathematical ideas on non-mathematical contexts for discussion in maths lesson. Teacher explains the resulting tribal conflicts. He discusses traditional ways of demarcating boundaries of a piece of land and **associates this to the cause of tribal conflicts**: code switching or reaching to local language. Didactical function: By recruiting the context of tribal conflicts, the teacher probably is trying to address the aims of the curriculum in relation to developing a **caring society**. This way he might be fostering moral and ethical values of reliability, co-operation, democracy, tolerance, mutual understanding. He might be trying to
	1304		**Mark:** Ho hoo	
			T: Yaah.	
			Mark: [Laughter]	
			T: Yah because- **Do you know where the problem is coming from**?	
			Ss: No	
			T: Eee?	
			Ss: No	
			T: Do you know where the problem is coming from measurement?	
	1315		Ss: No	

				develop the learner's social responsibility towards other individuals, the community and the nation as a whole. He might be trying to develop and enhance respect for and understanding and tolerance of, other peoples, beliefs, cultures and ways of life.
		1455	T: You know what. Traditionally when we are given the place you don't measure like that. You only go with a Headman. Eee? With a Headman.	**Theme 2:** Teacher explains the resulting tribal conflicts and **associates this to the cause of tribal conflicts**. **Link version2**: Need of mathematics knowledge in mediating. tribal conflicts **Domain**: *Public* because there seems to be a move towards mathematics. *Public* because its **Mode of expression** is weakly classified. The teacher's statement: (now that is what we call a **perimeter**) is a sign that this discussion moves towards mathematisation. The teacher explains the traditional ways of demarcating boundaries of a piece of land by the Headman. **Mode of expression:** weakly classified **Context:** Non-mathematical/non-specialised **Type of activity** drawn in: traditional ways of demarcating boundaries. *Fencing farm lands* **Classification of activity:** Weakly specialised/ classified **Type of setting** employed: Omangeti farms **Classification of setting**: Weakly specialised/ classified **Classification of everyday**: non-immediate- omangeti farms is some km away from school and surrounding villages. **Link version**: Drawing mathematical ideas on non-mathematical contexts for discussion of mathematical concepts or objects. For example, the teacher told this story about the Headman demarcating land and then links it to the maths concept of **perimeter**. **Link version:** *function in relation to new maths knowledge* **= theme 1** is a *preface* to *theme 2* or engagement. **Interaction**: Tts **Specialised vocabulary of signifier**: Perimeter **Title** drawn in**: headmen**
		1m13s	**Ss:** Yes	
	1324		**T**: Ta ende ashike nokakatana kaye peke. Ye o ta tete omuti nokakatana ka ye… kopa. (*He goes with his panga in his hand then he chops or marks the trees with his panga and say this is your place*). This is your place. You go from here. You go let me say he says from where. Yaah. He says start for example here… going around this dam and Nekwambi location there… and then from here… after the church there he cut another tree. He continues… after A B C he again cut another tree. Again until he comes from where he started. Ok. Now that is what we call a **perimeter**. Now the problem will comes like this. The person who is going to put a fence… that cut was not straight… you know. And the fence- make sure it has to be straight… hasho (isn't?). You have to put a pole there and another one there and another one there. Can you see now? Even to put it in a form of a square. Now sometimes may take a what- another place from somebody's place outside there or someone may include this one. Out li pamwe ndi shii? Shaashi winya okwa teta ashike a tete omuti ou… do omiti i na di li ukililafana ngaho **mos**. (*Are we together?)*	
	1430		**Anna**: Mmh (agree)	
			T: Eee?	
			Ss: Mmh (agree)	
			T: Opo u tule ko odalatate o i na okukala i li ngahelipi? O ya ukilil hasho? (*For you to **fence** it… how should it be like? It is not straight… isn't? Because that person just cut the trees randomly… and they were not in the straight line*.)	
	1433		**Ss:** Eee (yes)	
			T: It should be straight. Eee? Paime nee winya ota ti omuti winya o wange u li meni ou. Maar i ta dulu shili okuyamo. Wati ngaha odalate… we i ti ngaha… you see? You do like this… you do like this. You see. Now the problem will come. Aaye okwa kufa ko onhele yange. Okwa li ndi na oku enda apa. Onde i pewa ku mwenewomukunda. Omatendululo vali oo.	

			(*Because that person just cut the trees randomly… and they were not in the straight line. For you to fence it… how should it be like? Now you find this person is saying that tree is mine but honestly speaking he/she cannot enter somebody else's* ***fencing***. Now the problem will come. *You would hear this person saying this one took some of my place. I was supposed to pass here or come up to here. The* ***Headman*** *gave me this place. Now it is re-demarcation is required again*). That is why it is always very… very important to do measurement. Are we together?	
	1458		**Ss**: Mmh (agree)	
		1525	**T**: That's why even you need to know. If you know it is not going to be difficult for you. Even if you go to South Africa… eee? You only look to the what- information boards. The one you find on the roads there.	**Episode 13:** **Topic**: Measurement **Theme**: Going to South Africa and reading information boards. **Mode of expression:** Weak classification **Context** = non-mathematical **Type of activity** drawn in**:** reading information boards. **Classification of activity:** Weakly specialised/classified **Type of setting** employed**:** a country SA **Classification of setting:** Weakly specialised/classified **Classification of everyday:** non-immediate **Vocabulary of specialised Signifiers:** kilometres **Domain**: Public- Mode of expression is Weak classification on both expression and content. Vocabulary of signifiers (**km**) signals a move towards maths. **Interaction**:
		30s	**Saima:** Mm	
			T: Eee?	
			Saima: Mm	
			T: Just read in maps then you say ahaa… now from here to here is only these **kilometres**. Then now I have to go that side and make sure I have to come reach here before the sunset. Are we together?	
			Sos: yes	
			T: That is why It is always good to take measurements.	
		1624	**T** continues**:** Ok. Apart from length… what do we have again? Eee?	**Episode 14**: **Topic**: Area **Theme 1**: Discussing Area and naming its units of measurement **Mode of expression:** weakly classified **Context:** mathematical/specialised **Type of activity:** mathematical **Type of setting** employed: None **Vocabulary of specialised Signifiers:** km, km^2, mm, cm, **Domain**: Esoteric **Interaction**: Tac
			Setson: Area	
		59s	**T:** Eee?	
			Ss: Area	
			T: We have **area**. (( )) Area… isn't?	
			Ss: Yes	
			T: Eee?	
			T: Yes	
			T: What are the **units for area**?	
	1602		**Sos**: Kilometres… square kilometres… Kilometres… kilometres square.	
			T: People… in most cases the instruments are the same. The only difference is only the units.	
			Nali: Yes	
			T: Eee?	
			Ss: Yes	
			T: Millimetres square	

			Ss: Centimetres square	
			T: Centimetres square	
			Ss: Mitre square	
			T: Metre square	
			Ss: Kilometre squared	
			T: Kilometre	
			Nali: Hectopas [sic]	
	1618		**T**: And hectares no square.	
			Ss: Mmh	
			T: Because **hectares** can also be part of metres. Are we together?	
			Ss: Yes	
		1701 **37s**	**T**: Then you should know that is a complete **area**… A **space**… not like length. Ee… We can use um length as what- like in a form a **perimeter** where you **surround your place**. Are we together?	**Topic**: Area **Theme 2** : **Mode of expression:** weakly classified **Context:** Mathematical/specialised **Type of activity:** determining *square metres for the Erf* **Classification of activity:** Weakly specialised /classified **Type of setting** employed: Hearing from the Town council e.g. how big is your plot. **Classification of setting**: Weakly specialised /classified **Vocabulary of specialised Signifiers**: perimeter, area. **Vocabulary of non-specialised Signifiers**: inside space **Classification of everyday**: authentic & immediate **Interaction**: Tp **Domain:** Expressive domain and it is other type of expressive domain. Teacher uses the word ***inside space*** (*Signifier*) to refer to or explain a maths concept **Area** (*signified*). It is other type of expressive domain different from Dowling's because in Dowling scheme the non-mathematics activity is recontextualised and mathematized. i.e. the gaze is evident. Here it is just only a reference that is made and no calculations.
			Ss: Yes	
			T: But… when you **talk of the area** we talk about the **inside space**. The inside space. Are we together?	
			Ss: Yes	
			T: That is why we use squares. That is why squares. Yaah. Again maybe you use to hear from the Town council. Ha no o plota yoye o i na eeshikweya ngapi? *(How many square metres is your Erf?)*	
			Nali: Oh aaye. (*Oh no*)	
			T: Hasho? (*Isn't?)*	
			Saima: Eee (*agree*)	
			T: Eee?	
			Ss: Eee.	
	1704	**1756** **55s**	**T**: Let me ask you people. Now… currently now… let me say we **go to the new school**. Mmh? Tell me… **how many square kilometres does our school has?** The area.	**Episode 15**: **Topic:** Area **Theme**: Reading the size of their new school in km^2 from the noticeboard. **Mode of expression:** weakly classified **Context:** Non-mathematical/non-specialised- reading numbers is non-mathematical. **Type of activity** drawn in**:** reading information about the size of the new school. **Classification of activity:** Weakly specialised /classified **Type of setting** employed: students' new school **Classification of setting**: Weakly specialised /classified **Classification of everyday**: Authentic & Immediate **Vocabulary of specialised Signifiers**: km^2
			Ss: (( ))	
			T: Yayee… your own schoola? [sic] How many of you have visited that school?	
			Naango: Just-	
			T: How many of you have visited that school?	
			Naango: We just looked at it on top. *Perhaps the learner wanted to say we just look at it from outside.*	
			T: Eee?	

			Ss: [laughter]	**Domain**: <u>Public</u>- public domain because not looked from the perspective of maths. It is about mathematics and the move is towards mathematics. **Interaction**: Tac
			T: You just looked at it on topa [sic]? Yaah. People… that is your homework today. You must **go there and read from that board** that is put there. It is there written there. You should **know how many square kilometres** our school has. Are we together?	
			Ch: Yes Sir.	
			T: Eee?	
			Ss: Yes Sir	
			T: Just go there and read it. That is why I say **measurement is** very… very **important**.	
	1800	**1827** **31s**	**T** (proceeds): Apart from that one we have also a **volume**. Volume yes. Volume… volume. Again in Volume… the only difference is that we only add a unit. These are the same.	**Episode 16** **Topic**: Measurement **Theme 1**: Volume **Mode of expression:** Strongly institutionalised– Though it is just mere listing of unit of measure, the teacher is explaining **Volume** which is a highly institutionalised mathematical term. **Context:** mathematical/specialised **Type of activity:** mathematical **Type of setting** employed: None **Vocabulary of specialised Signifiers:** Volume & its units of measure **Domain**: <u>Esoteric</u> = this text deploys exclusively technical mathematical signs/ specialised **Interaction**: NL
			Soini: Mm (agree)	
			Salmi: Centimetres	
			T: Cubic centimetres…	
			Salmi: Cubic metres	
			T: Cubic metres…	
			Tom: Cubic kilometres	
	1826	**1859** **32s**	**T:** Cubic kilometres and so on. So people… in most cases the only measure we use is about the **Capacity**. Capacity.	**Theme 2**: **Capacity** **Mode of expression:** Strongly institutionalised – Though it is just mere listing of unit of measure, the teacher is explaining **capacity** which is a highly institutionalised mathematical term. **Context:** Mathematical/specialised **Type of activity** drawn in: Mathematical- listing units measure of capacity **Classification of activity:** Weakly specialised/classified-because this is just mere naming. **Type of setting** employed: None **Vocabulary of specialised Signifiers:** Capacity & its units of measure **Domain**: <u>Esoteric</u>-= this text deploys exclusively technical mathematical signs/ specialised **Interaction**: NL
			Carlo: Capacity?	
			T: Yes.	
			Chaka: Millilitres	
			T: We have millilitres…isn't?	
			Loide: Yes. Litres	
			T: Litres	
			Nekulu: Kilolitres	
			T: Kilolitres… isn't? And so on.	
		1934 **40s**	**T** (proceeds): And other one is what?	**Theme 3**: Mass **Mode of expression:** strongly institutionalised **`Context:** mathematical/specialised **Type of activity:** mathematical- naming unit of measuring mass. **Classification of activity**: For the same reason, this is higly specialised
	1900		**Saima**: Mass	
			T: Mass… mass.	
			Saima: Grams.	
			T: Grams.	

			Ss: Kilograms	**Type of setting** employed: None **Vocabulary of specialised Signifiers:** Mass & its units of measure **Domain**: Esoteric = this text deploys exclusively technical mathematical signs/ specialised **Interaction**: NL
			T: Alex… are you fine? Are you fine?	
			Alex: Yes	
			T: (( )) eehe Kilograms.	
			Ss: Milligrams	
			T: And what did you say before? And what?	
			Erkie: Ee? (Pardon me?)	
			Touno: Tons.	
			T: Tons. People… all these are measurements.	
	1932	**2000**	**T** (proceed): A **volume… eee?…** is **the inside space of any container**. It is what we call a volume.	**Theme 4**: defining concept volume **Mode of expression:** weakly institutionalised **Context:** mathematical/specialised **Domain:** Expressive domain and it is other type of expressive domain. Teacher uses the word ***inside space*** (*Signifier*) to refer to or explain a maths concept **Volume** (*signified*). That is another form of expression is embedded. **Interaction**: **Tp**
		21s	**Tertu:** Ohoo… a containter.	
			T: Out li pamwe ndishii? (*We are together right*?).	
			Tertu: Mm (yes)	
			T: So… may be if you want to know **amount of water that a** ((container)) **can carry** you have to measure it. You have to know it. Eee?	
			Tertu: Mm (yes)	
	2000	**2050**	**T**: If you **want to know how much you need in order to satisfy. Ila kofikola opo u ha nyokomwe**. (*Come to school so that you will not be cheated*).	**Episode 17**: **Topic:** Measurement **Theme:** Measuring the volume of one's stomach and the significance of schooling. Teacher discusses the need to measure the volume of our stomachs. **Mode of expression:** Weakly classified **Context:** Non-mathematical - activity of measuring stomachs. **Type of activity** drawn in**:** activity of measuring stomachs. **Classification of activity:** Weakly specialised /classified **Type of setting** employed: School **Classification of setting**: Weakly specialised /classified **Classification of everyday**: *Inauthentic* and *Immediate* **Domain**: Public- other type of public domain- not looked from the perspective of maths. *Public* = this text deploys signs where the expression (signifier) and content (signified) are arbitrary with respect to mathematics (Dowling, 2007, p. 5). Generally the texts concerned could be considered as applications of mathematics. Link version = Utilisation of made up or make belief stories or examples. **Interaction**: **Tp** **Inauthentic** because this is a made-up (make-belief) example.
			Ss: [Laughter]	
		50s	**T:** Eee? Eee? You must know the volume of your stomach... hasho (isn't?).	
			Tery: Aaye (*no*)	
			Nangula: Yes.	
			Terry: I cannot.	
			T: You must know the volume of your stomach.	
			Sos: Yes… No… Aaye.	
			T: Eee?	
			Sos: Yes… No… Aaye (*No*).	
			T: Eee?	
			Sos: Yes… No… Aaye.	
	2020		**T**: Oh… you have to measure the food you eat…isn't?	
			Terry: Oh!	
			Ss: Aaye (No).	
			T: (( ))	
			Shetu: Maar yes.	
			T: No	
			T: Eee?	

			Mark: No	How can one measure the volume of his stomach? Is this just **a made up story**? If it is what for? The teacher seems to suggest that this is done by measuring the amount one eats. **Discriminatory nature of contextualised teaching**: Like me, some learners here still do not agree that a person can measure the volume of her stomach. If the volume of the stomach is measured by the food we eat, how do me call this unit of measurement? Is it 2 apples? Is it 2 plates? In actual measurement, we can say it takes 300 litres can to fill a 1.5 Toyota Corolla. Can I also say it take 2 apple to fill the volume of my stomach? If I am filled by 2 apples today can this stand always?
			Shetu: Yes Bra ove. Ngeenge okayaxa okashona—okayaxa kashona i to kuta mos. Maar ngee oka kula ndee owa fya ondjala oto dulu okumona kutya paife ngaha onda kuta. (*You… if the **plate is small you will not be satisfied**. But… if it is big **you can feel** that you are full*.)	
	2040		**Mark**: Maar oto dulu uka wede mo ashike. (*But you can add more*.) **S**: Ngee ino kuta oto ka lya ashike ouleke. (*You can just go and eat sweets if you are not full or satisfied.*).	
			T: (( )) my volume now I'm gonna need is this one… then you measure those cakes. The volume of those cakes.	
Revision (2)		**2100** **10s**	**T** proceeds: I think you have **learnt how to measure irregular object**s… hasho?	**Episode 18** **Topic**: Measurement **Theme 1 :** measuring irregular objects **Mode of expression:** weakly classified /instutionalised **Context:** mathematical & `scientific - activity of measuring irregular objects **Type of activity** drawn in**:** Taking measurement of irregular objects **Classification of activity:** Weakly specialised /classified **Classification of everyday**: Authentic & Immediate **Domain**: Public- weakly classified **Interaction**: Wd
			Ss: Yes	
			T: By using what?	
			Salmi: Water.	
			T: In Physical Science we use what?	
			Salmi: Water.	
			T: No	
			Ss: Yes Sir	
			T: And what? What is the instrument?	
			Salmi: Water.	
		2117 **17s**	**T**: **What is the instrument we use when we measure irregular objects**?	**Theme 2 :** Naming the instrument for measuring irregular objects **Mode of expression:** Weakly classified **Context:** mathematical/specialised **Type of activity:** Mathematical- measuring irregular objects **Classification of activity**: weakly specialised -because this is just mere naming. **Type of setting** employed: None **Vocabulary of specialised Signifier:** Measuring cylinder **Domain**: <u>Esoteric</u> = this text deploys exclusively technical mathematical sign/ specialised
			Kaino: Cylinder.	
			T: Eee… we have a… measuring?	
			Ch: Cylinder.	
			T: Eee?	
	2113		**Kaino**: Measuring cylinder.	
			T: Measuring cylinder. We have a measuring? Ok.	
		2140 **23s**	**T** (proceed): What about the **mass**? Which instrument do we use?	**Theme 3 :** Naming the instrument for measuring Mass **Mode of expression:** Weakly classified **Context:** mathematical/specialised **Type of activity:** can be Mathematical or non-mathematical measuring mass **Classification of activity**: weakly specialised -because this is just mere naming of instruments of measuring mass. **Type of setting** employed: None **Vocabulary of specialised Signifier:** Measuring cylinder **Domain:** <u>public</u> = this text deploys technical mathematical signs/ specialised
			Selma: Measuring cylinder	
			T: Eee?	
			Selma: A scale	
			T: A Kitchen scale	
			Sem: Bathroom scale	
			T: Bathroom scale	
			Saskar: (( )) scale	
			T: Eee? And what else?	

			Saskar: Kitchen scale	
			T: Eee?	
			Saskar: Kitchen scale	
			Sonia: Kitchen scale is already mentioned.	
			T: Those things are playing a role.	
	2140	**2224** **44s**	**T** (proceed): What about the **tins**?	**Topic:** Measuring irregular objects **Theme 4**: Measuring with tins and Ohahida Teacher discusses further ways of measuring irregular objects with **tins.** **Mode of expression:** Weakly classified **Context: non-**mathematical/non-specialised **Type of activity** non-mathematical –traditional way battering or exchanging millet for meat (beef). **Classification of activity**: weakly specialised - **Type of setting** employed: None **Vocabulary of specialised Signifier:** none **classification of everyday**: *Authentic* and *immediate* **Authentic** because this is could be a lived –through experience as some students may have experience it **Interaction**: Wd **Domain**: other public = text deploy signs where the expression and content are arbitrary with respect to mathematics. Texts concerned generally could be considered as applications of mathematics by the teacher. **Function** = promoting the importance of measurement.
			Sara: Tins?	
			T: Ee.	
			Sara: Grams	
			T: Anyone who saw people measuring using that one?	
			Ss: (( ))	
			T: Eee?	
			Kakunya: Yes	
			T: Unona onye? Omu li ashike modoolopa ndishi? (*You kids… you are just town people… right*? Ovanhu ngee tava hahida nande ombelela oha va longifa shike? Iilya. (*When people exchange millet for meat… what do they use?*).	
			Kakunya : Oindoosa (*Tins*)	
	2200		**T:** Eee?	
			Ss: Oundooxa (*Tins*)	
			T: Oundoosa opo ku ha nyokome mukweni… hasho? (*Tins are used so that you will not cheat each other… isn't?*).	
			Ss: Eee (yes).	
			T: (( )) ndee eeranda ngapi? Eee? Owa sha okunyokoma ondooxa netata. Shaashi ito dulu okumeta naanaa noupu mos… hasho? *(( )) how much in Rands? Basically, you need to be cheated a tin and half just because you cannot measure accurately… isn't?*)	
			Neema: Yes	
			T: They are using that one.	
			Ss: (( ))	
			T: Even- Eee?	
			Ss: (( ))	
			T: Yaah… every place you know. Every place. That is what we use.	
Sharing & Develo ping Knew		**2458** **2m34s**	**T** proceeds: Ok. People. You can read through this one on how people measure. While you are busy writing… any question? Any question? Yes… Kamati.	**Episode 19:** **Topic:** Questions session **Theme:** Teacher explains to the student what a hectare is. **Mode of expression:** weakly classified **Context:** Non-mathematical/non-specialised
			Kamati: Why is **hectares** not added to **volume**?	
			T: What?	

knowledge (3)			**Kamati:** Why is hectares not added to volume?	**Type of activity** drawn in: determining the volume of a dam. **Classification of activity:** Weakly specialised /classified – because this is just a mere example with no calculation or gaze. **Type of setting** employed: a dam **Classification of setting**: Weakly specialised/classified **Classification of everyday**: *Authentic* and Immediate Authentic because this is could be a lived –through experience as some students may have experience it. **Vocabulary of specialised Signifier:** hectares, volume, area **Domain**: Esoteric- this is a strong pedagogy and it is strongly framed. Teacher has the legitimate criteria and he is transmitting it to the students. This discussion is clearly about mathematics and the text that deploys technical mathematical signs /objects (e.g. hectares, area, litres, ten thousands metres etc.) **Interaction**: Tp
			T: Hectares? Eee?	
	2255		**Kamati :** Yes	
			T: Very good. **Hectare is used for the area**… the place… area. While the **volume is how much the container should carry?** Do you understand? Eee? **Like we have a dam.** We say **the volume of a dam**. **This dam can contain how many litres of water? Are we together**?	
			S: Yes sir	
			T: Or a certain **cylinder**. This one can contain how many what- litres of water. But **hectare is just used for the area.** For example… this **farmer** is going to have um **ten hectares**. That is why sometimes we use metres and convert them to hectares. Are we together? And we learnt about that one. For example **ten thousands metres**. If you cover this distance- metre square is the same as one hectare. Can you see now? Just like when you say **one thousand metres** is the same as **one kilometre**. Are we together?	
			Ss: Yes	
	2400		**T**: And we are going to learn about that one. Yaah... that's why a chapter is not yet complete. (( )).	
			T: Some are (( ))?	
			Set: No	
			T: Mmm?	
			Set: Yaah	
			T: How many people have books to write it?	
			Ss: (( ))	
			T: (( )) books?	
			Salmon: They are three… three books.	
			T: (( )) They are three. Ok. [pause] Do not forget to make a turn at your new school and tell me the area of that school. Eee? It is your school but you do not know the what- the area of that. Omwa konneka ashike eshi omatungo e lilonda? (Have just noticed that some rooms are on top of each other?)	
			Salmi: Eee (yes)	
			T: Mmm?	
			Ss: [laughter]	
			Sos: Sir it is far… Okokule… is too kokule… (*Is too far).*	
		2557	**T** (proceeds): People… do you know one thing? Eee?	**Episode 20** **Topic: Measurement**
			Saima: Yes	
		1m59s	**Ss:** No	

	2504		**T:** Me when I take measurement ne… I make it easier. You know why?	Theme: Teacher uses his normal walk as an example. **Mode of expression:** weakly classified **Context:** Non-mathematical/non-specialised **Type of activity** drawn in**:** measuring walking steps **Classification of activity:** non-specialised **Type of setting** employed: none **Classification of everyday**: authentic & Immediate Link version = Utilisation of made up or make belief stories or examples. **Domain**: *Public* = text deploys signs where the expression is arbitrary with respect to mathematics. The only vocabulary of specialised Signifier present is metre. Texts concerned generally could be considered as applications of mathematics. **Interaction**: Tst
			Sem: Why?	
			T: My normal working is **one metre.**	
			Salmon: Ee? (What?)	
			T: My **normal working is one metre**. Just look… like this I am working one metre.	
			Kaino: Oh.	
			Salmon: [Laugh]	
			T: It is true.	
			Kaino: But it is not always.	
			T: Eee?	
			Kaino: It's not always.	
			T: Ok… just check me once a time ne. Don't let me know that-	
			Salmon: When you are walking seriously like-	
			T: Do not let me know that you are going to measure it. Just check me one day when I am passing somewhere. Then take note and come take a metre and you measure it and tell me.	
			S: Ah	
	2545		**T**: It is true. Just watch me walking somewhere. Then you come and measure it.	
			Tomas: Yes Sir	
			Kaino: Aaye (*no*)	
			T: Are you done?	
			Ss: No Sir.	
Practice (run concurrently with the following section on **revision**)	2600	**2635** **20s**	**T**: Remember this is the first one. Start with this one. Number two… number three… number four and number five. Iyaah… in the paper I gave you… we do not have all of those ones. We only have to **convert from one unit to another one**. Are we together?	**Episode 21:** **Topic:** Practice/homework **Theme:** Teacher gives practical task **Example**: It is taken from the book. **Mode of expression:** specialised **Context:** Mathematical **Domain**: Esoteric because students are asked to **convert** from one unit to another. **Interaction**: Sc
			Ss: Yes	
			T: Ok**.** Mmh… Eee?	
			Ss: (( ))	
Revision (7min)			**T:** Ok. [pause] Ok… Girls… when you are cooking… how do you make sure that the flour is enough for the porridge? The porridge is enough for everybody? Do you measure it? Or how do you do it?	**Episode 22:** **Topic:** Measurement and Oshifima cooking **Theme 1**: Discussion on how girls cook oshifima **Mode of expression:** Weakly institutionalised/specialised **Context:** non-mathematical
	2700		**Tresia:** Everyone is a (( ))	
			T: Girls… how many of you know how to cook oshifima… Porridge? Eee?	

	Salmi: Boys?
	T: Ok. [laugh] Maria… how do you know the porridge you are cooking is enough for everybody?
	Maria: [Silence] I take a jar.
	T: Eee? You take a what?
	Maria: A Jar
	T: Mh?
	Maria : Then (( ))
	Sonia: Two Jars
	T: You put what?
	Maria: Two jars of water. It is enough.
	T: It is enough?
	Maria: Yes
	T: Ok. Let me say- Ok. You are may be five in the house. What about two people coming again?
2800	**Maria:** I am going to add a half jar.
	T: You take two jars and half?
	Maria : Yes
	T: Eee?
	Maria : Yes
	T: What about if um five people come in again?
	Seena: Oh
	T: Yes
	[learners speak among themselves] **Maria:** I put two or three.
2820	**T**: Three again? [laughing]
	Maria : Yes
	Katrina: What if you are not cooking in the pot?
	T: What about when you put this um uusila? (*What about adding flour*). How do you measure it? You just take a-
	Maria : I just take-
	T: Eee? You do what?

Type of activity drawn in: domestic cooking activity
Classification of activity: non-specialised
Classification of everyday: authentic & Immediate
Vocabulary of specialised Signifier: Two, half, five.
Domain: Public- other type of public domain- This discussion is about cooking enough porrige (oshifima) in a traditional/cultural setting. Here, motly, children learn by mere observing the expert doing it. One might not all need mathematics to do this task/ house chore. Secondly, the main theme being discussed here is Mensuration (**Measurement,** as the teacher puts it) and not **Proportion**. It the main theme was proportion, then I would say the teacher is actually exploring the idea of direct proportion or indirect/inverse proportion. In proportion, the teachers may explore this by asking what happens if the quantity needs to be increased to cater for more people.

Interaction: Wd

Public according to (Dowling, 2007, p. 5) because the language is weakly institutionalised. That is this text deploy signs where the expression and content are arbitrary with respect to mathematics. Examples of such texts may generally be considered to be applications of mathematics— e.g. shopping and financial activities and so on. (Dowling, 2007, p. 5).
The teacher says we measure when we cook Oshifima but this traditional cooking activity of oshifima is only based of *intuition* I would say, and not mathematical estimation.

Didactical function: The **National Broad Curriculum for Basic Education (2010)** in *Namibia states that Namibia is a fair, gender-responsive, caring and committed nation/.* By recruiting a cooking Oshifima activity or context, the teacher might be trying **to promote cultural identity**. However by focusing on how girls cook, the teacher may not only promote gender inequality, but discourage future equality of opportunity for males and females. The **National curriculum for basic Education** clearly states that teaching need to enable all learners (irrespective of gender) realise that they can equally and fully participate in all spheres of society and in all fields of employment. Similarly, **the 2010 MATHEMATICS SYLLABUS for GRADES 8 – 10** warns that "teachers should know and understand how to treat learners equally, and all materials should support gender equity. Teachers must be aware of the ways in which boys or girls often become favouritised in the classroom interaction, and ensure that their role promotes gender equity."

Reference:
1. Ministry of Basic Education. (2008, 2010). *The National Curriculum for Basic*

				Education. Okahandja: National Institute for Educational Development (NIED). Retrieved from http://www.nied.edu.na/images/National%20Curriculum%20for%20Basic%20Education%20Jan10.pdf. 2. Ministry of Education. (2010). *Junior Secondary Phase Mathematics Syllabus: Grade 8-10 including Additional Mathematics Grade 9-10*. Okahandia: National Institute for Educational Development (NIED).
		3007	**T (**proceds**):** Eee… Martha how do you- Let me say how do you measure it? When you are cooking in the pot… how do you measure it? Eee?	**Theme 2**: Teacher encourages a student to speak in a preferable language. Public- other type of public domain- not looked from the perspective of maths. **Link version: Code- switching**: Student is encouraged to put it in a language of her choice.
			Martha : (( ))	
		1m25s	**T:** You have to do what?	
	2908		**Martha :** [Silence]	
			T: Ok you can say it in a language you prefer if it is difficult… in a language you prefer.	
			Martha: Uusila? (F*lour*?)	
			T: Eee (Yes).	
			Martha : Ohandi kufa nande okakopi. Ha ndi mixisa nokakopi… ha ndi tula mo oufila… ndee handi pilulamo. (*I usually take the cup… mix the flour and stir.*)	
			T: Oshithima i ta shi pama sha pitilila? (Is the porridge (dough) not becoming harder?)	
			Martha : Ee… ota shi pama. (Yes… it becomes saturated.)	
	2932		**T:** Eee?	
			Kaimba: Sir?	
			T: Yes!	
			Kaimba: Ongeenge handi tu lamo okandobo ile ongeenge mombiya ya dikilwa? (*Are you referring to the case when I usually mix flour with water in the cup or when I putting the flour directly in the pot?)*	
			T: Ombiya to tula mo oufila mwoovene. (*It is when you put the floor directly*).	
			Kaimba: Tete oto ningi- oto tula mo oufila mombiya. To pilula to pilula. Ngeenge i na shi pama to weda mo natango. Konima natango ngee ina shi pama nawa to weda mo vali oufila. (*First you put floor in the pot and stir. If it is not yet saturated then you add more flour. After that you do the same if it is not yet saturated.)*	
			T: Ngaho owa meaninga shike? (*What do you mean?)*	
			Kaimba: Nda meaninga shike Sir?	
			T: Ee?	
	2956		**Kaimba:** Omunhu ndishi oto teleke. Onyala imwe eshi to teleke onyala imwe	

			otai tulamo oufila. Oto tulamo eke ita li yada unene. Ngeenge tete owa tula la mo eke liyadi nale ndee ina shi pama oto tula mo vali oufila. (*What I mean? You are cooking. When you cooking one hand is adding flour. When you add floor you do not put a handful. If you previously add a handful and it is not yet saturated then you add more.*)	
		3130	**T:** So first you put a **full hand** and you keep on putting a **half**. A half and a half. Eee… **Nangula… how do you cook**? Mmh?	**Theme 3**: **Mode of expression:** Weakly classified and the language is unspecialised. **Context: non-mathematical =** domestic activity of cooking **Classification of everyday)**: Authentic and immediate **Domain**: *Public* according to (Dowling, 2007, p. 5) this text deploys signs where the expression is arbitrary with respect to mathematics. Examples of such texts may generally be considered to be applications of mathematics— e.g. shopping and financial activities and so on. (Dowling, 2007, p. 5). Interaction: **Sc**
		1m23s	**Nangula**: It is like-- It is like when I take two jars. I put water- I put the water in and then I put- I make sure that always if my hand is full of the flour I put on- I put in two. I put one is full and one is half then I know it is right.	
			T: People… Ok. Let me ask you. When doing that one… are you- **do you know that you are doing measurement? Or you are doing mathematics?**	
			Ss: Yes	
			T: How do you know? Eee? Why don't you say go and cook and use mathematics?	
			Ss: [Laughter]	
			Nangula: Obviously oh.	**On the other hand, the highlited text somehow seems to point to the myh of reference because the discussion points to the idea that mathematics is there to describe other non-mathematics activies. If this is taken to be the case, then this piece of text would be associated with the esoteric domain.**
			T: Eee?	
			Nangula : Obviously you have to measure the flour.	
			T: Ok. So you want to tell me that mathematics is everywhere.	
			Ss: Yes	
			T: In whatsoever you are doing there is always a?	
			Ss: Maths	
			T: Mathematics.	
	3106		**T** (proceeds): **Omwa mana ku copying ne? (Are you done copying?**	
			Ss: Yes	
			T: So… some other questions?	
			Ss: (( ))	
			T: Eee?	
			Mark: No	
			Sacky: No. You… ask. *A learner tells the other learner to ask.*	
	3125		**T**: Ok… so people… we will continue tomorrow. Eee?	
			Ch: Yes	
		3306	**T**: We will continue tomorrow and what I want from you is this. Only one thing. Eee?	**Episode** 23: **Topic**: Giving another assignment/homework
			Ch: Yes	

	3140	1m36s	**T**: When you go home… ask your parents. **What do people used to use when measuring- doing measurements**. [sic] More especially those who did not know how to read and write. Eee?	**Theme**: Seeking info on ancient systems of measurement **Link version:** Drawing on parental practical experience. **Mode of expression:** weakly classified/non- specialised **Context:** non-mathematical activity **Type of activity** drawn in: - a task where learners are asked to go and ask parents about the ancient methods of measurement. **Classification of activity:** non-specialised **Type of setting** employed: village **Classification of setting**: Weakly specialised/ classified **Classification of everyday**: Authentic and Immediate **Domain**: *Other types of* ***Public domain***- Although the talk about the domestic activity of measurement is recontextualised it is not looked from the gaze of maths. There are no calculations in this task.
			Mathew: At the village?	
			T: Aam…	
			Setson: [Laughter]	
			T: Tomorrow when you come back- when we come here-before the lesson starts I want my homework. Go and ask elders.	
	3202		**Siyuka:** Yee? (Excuse me?)	
			T: Ta mu ka pula aakulunhu kutya aanhu nale okwa li ha va metifa shike hano? Eee? (*Go and ask elders about what they normally use when they measure*). I do not want the answers now. Ok. Ndee ta mu va pula yo kutya (*Again ask them*), how did you find this and calculate it properly? Eee? Omuuditeko ndi shii? (*Do you understand*?)	
	3230		**Ss:** Eee	
			T: You go and do what? You ask your parents. Eee? Tell Kaino and who?	
			Siyuka: And Heelu	
			T: And Heelu. Ok	
			Simon: Sir	
			T: That is for your homework tomorrow. Eee? You bring it.	
			Setson: You mark it	
	3300		**T**: And I'll mark it… record it and we compare it with nowadays situation whereby people use in most case measurement. Eee? Iyaa… hano eemeasurement oda pumbiwa unona yee. (So children, measurements are necessary.)	
			Ss: Eee (alright)	
			T: Opo tu kelele iinima ihapu. (*So that we prevent the unnecessary).*	
Sharing & Developing Knew knowledge (2min)		**3451**	**T** (proceeds): Omu shii tuu kutya nomapya ohaa metwa? *Do you know that even farmlands (crop fields) can be measured?*).	**Episode 24** **Topic**: Measuring a piece of land ploughed by a tractor.(non-mathematical means of Measurement) **Mode of expression:** Weakly classified/non- specialised. **Mode of expression:** weakly classified/non- specialised. **Context:** non-mathematical activity **Type of activity** drawn in: Measuring the ploughed land by tractor. **Classification of activity:** non-specialised **Type of setting** employed: unspecified but this is again an activity of the village life. **Classification of setting**: Weakly specialised/ classified
			Ss: Ee (yes)	
			T: Ohaa metwa ngahelipi? (*How are they measured*?	
		1m45s	**Shanghala**: Oneemhadi (*They are measured with feet*)	
	3312		**T**: Nashike? (With what?)	
			Shanghala: Neemhadi. (with feet)	
			T: Neemhadi? (With feet?)	
			Ss: Ee (Yes).	
			T: Eee? Vamwe vati oha vati onovili ya mbakumbaku. Is that true? Vati shaa	

			ngoo vali- Ngeenge vati sha ma kwa pulula eevili di li mbali vati o two hectares. (*Some people say they are measured with tractors. Is that true? They say one hour of tractor ploughing a particular piece of land is equivalent to a hectare. If a tractor plough a piece of land for two hours then that piece of ploughed land isregarded as two hectares.*)	**Classification of everyday**: Authentic and Immediate **Vocabulary of specialised Signifiers**: *two, speed* **Domain**: Other types of ***Public domain***- though the talk of domestic activity of measurement (measuring ploughing done by a tractor) is recontextualised, it is not looked from the gaze of maths. There are no calculations in this task. Same applies what was discussed in **Episode 22**, this discussion is about measuring communal land, as well as the ploughed land done by a tractor in a traditional/cultural setting. Here, mostly, people in villages learn to do this task by observing the elders doing it. A person does not make use of mathematics to do this task. Secondly, the main theme being discussed here is **Mensuration** (**Measurement** as the teacher puts it**)** and not **Ratio** and **Proportion**. It the main theme was Ratio and Proportion, then I would say the teacher is actually exploring and the learner relating the length of ploughing to the speed, hence moving towards ratio relationship. If this was the case, I would have said there is a move towars recognising a mathematical relationship. **Interaction**: Whole class discussion (**wcd**). **Link version:** drawing maths ideas from non-mathematical contexts
			Simon: Ah	
			T: Is that true?	
			Ss: Aaye (No) [*laughter*]	
			T: Eee?	
			Simeone: We do not know.	
	3340		**T:** Is that true? Sha ma a pulula eevili mbali da mbakumbaku vati is two hectres. (*It is believed that if a tractor plough the piece of land for two hours then that is interpreted as two hectres. Is that true?*)	
			Saama: Ngeenge ota li ende kashona Sir? (*What if the tractor is moving at a slow* ***speed****?*)	
			Sem: We are not sure because we never saw it Sir.	
			T: You are not sure?	
			Sem: No	
			S: (( )) mongula.	
	3350		**T:** Eee? (( )) mongula? Ok… just come to me there. Ok people… it is break time. Do not forget to ask your parents what they used to do measurements.	
	3451		**The End**	

Appendix 7: Significance and benefits of the introductory pages of mathematics syllabus

Subject Advisors did not only interpret the declamatory statement in ways above, they also made reference to the significance of introductory pages of the syllabus where the statement is taken from. To display the significance of the declamatory statement, as well as the need teachers to consider this part of the syllabus, I present advisors' articulations that point to this below:

For example, in highlighting the significance of the introductory part of the syllabus, Ms Botham revealed that:

> *The introductory part gives you the aim. The introductory part of the syllabus gives you the learning outcomes first- no. First is the rationale. Why you have to teach the subject. Then under the rationale you have the aims of the subject. And then you have the competencies and learning outcomes. What do you expect learners to have upon completing that phase, because our syllabi are phase-based. It's an Upper Primary syllabus which have got grade five, six and seven. So how do you deal with learners with disabilities in your class if you are teaching a subject now. It also have the particular features of the subject and that phase, as well as the syllabus plan, how is the syllabus planned and how do you link the syllabus to the other subjects. Those are the cross curriculum. We also have the information on how the teacher should deal with gender and how to deal with local context, how to apply what the learners are learning in your subject, in their local environment and also the approaches which the teacher can use to teach the subject.*

This quote reveals that the introductory part in the Mathematics syllabus contains main features about the overall plan of the syllabus, as well as the important aspects of the subject at each phase. These features include the Rationales for teaching maths, Link of the mathematics subject to other subjects (cross-curricular issues), and guides on how to handle Gender issues, Local context and content, as well as some aspects on the Approach to teaching mathematics. These are important aspects that mathematics teachers might need to consider when they plan their lessons.

Significance and benefits from the declamatory statement

Ms Botham perceived the curriculum declamatory statement as a crucial component of the syllabus that all mathematics teachers need to consider.

> *I feel it is important for the teacher to read this because it is the one- it is a section which is giving you information on how to deal with the content that you have- the basic competencies that you have in the syllabus.*

Subject Advisors seem to be optimistic about the presence of the declamatory statement in both Upper primary and Junior secondary syllabi. Benefits that accompany the declamatory statement in terms of student learning were also revealed. For example Ms Botham relates:

> *The positive part of it, learners will be able to know the reason why they are doing mathematics. Learners will be able to use-to observe what is around them because if you open their eyes then they will be able to be observant and be critical and critically look at the issues and understand- be able to understand the content.*

In another example, Ms Jones perceive it as encouraging practical work, and ultimately improve student results.

> *I think it will help the concept of integrating um practical work into theory work they are doing in the classroom. I think it will help to improve the results, if they are to practice more or to integrate the knowledge that they get with real-life situations*.

Other benefits mentioned are that the statement (1) encourages reflection on what was learnt, and on why students are being taught certain aspects in mathematics. (2) It can change student perception that mathematics is difficult and could develop student interest. It makes students realise that most of the activities that they do at home are mathematics related activities. In it, there is a possibility of bringing mathematics closer to students and can make them realise that mathematics is not really something strange and unthinkable. Students tend to realise that mathematics is also about students, it is about what students love, is about what students know, and that, it is something that is with them. Others saw benefits of making students love the mathematics, others foresee that it could help improve performance and achievement. Some perceive it as having the ability to make learners understand mathematics better, while others perceive it in terms of promoting fairness in mathematics teaching. Advisors did not only talk about what is positive about the statement, some of them alluded to what they foresee as a possibility to jeopardise students' chance of learning mathematics content. For example, Ms Botham recalled:

> *The negative part of it comes when the teacher is not- do not understand it the way it's supposed to be done. Because instead of making links-- instead of contextualising, the teacher might just not do it. And if it is not done it has a negative effect on the learners, in the way they learn and the way they understand the content in mathematics.*

This demerit does not seem to lie in the declamatory statement itself, but in the way it is handled at the administrative level (in terms of teachers continuous professional development) and by school mathematics teachers themselves.

Appendix 8: Ideal ways of enacting the declamatory statement

Below I present Subject Advisors' opinions of what they suppose the statement could be implemented. In terms of Sloyer's proposal, (Sloyer's 1976), most of the examples mentioned here emphasise the lower level of mathematics application. Next, I present proposed examples that suggest low level mathematics application.

Highlighting what brainstorming could be like, Ms Irene suggested these are some of the things teachers could do in their lessons.

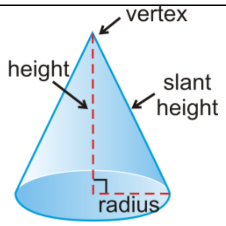
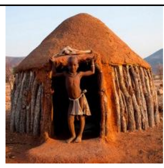
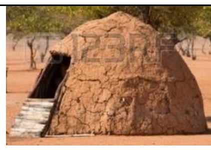
Asking the learners, you can ask them for example what kind of animals you have around here? How do you cook? Do you collect fruit for example?

The first two questions could be interpreted as suggesting a move towards generalisation. By generalisation, I mean this questions appears to suggest that mathematics is basically there describe other activities. The move towards generalisation could suggest the myth of reference, however, in this case, no signal of introducing students to mathematics objects and structures. For example, the question asking what kinds of animals around here requires the respondent to recall names of animals in the place. The question, ‘How do you cook?’ invites a respondent to give a general way of cooking. However, if a teacher asks: Do you collect fruits? This question lends the respondent to give a closed answer (e.g. yes or no). Attention might need to be paid to this administrators suggestions. Sloyer (1976b, p. 19) noted the ambiguity that lies in what actually constitutes application of mathematics. For Ms Irene, asking students what kind of animals you have around or at home, how students cook, and whether they collect fruit are some of the examples of how the declamatory statement could be implemented. These examples present the view of what constitutes mathematics application for this administrator. Ms Irene might have felt that by asking these questions an application of mathematics had been offered. If this is the case, according to Sloyer (1976), this constitutes a superficial view of the notion of mathematics application. The notable point here is that this form of sugar-coating in the name mathematics application can be aligned with the myth of participation, because it does not necessary lead to the esoteric domain of mathematics.

In another instance, Ms Botham suggested imagined or fantasized activities. Ms Botham used exemplars that signify activities students had engaged themselves in, or something that students had observed and experienced. She proposed,

If for example you are teaching Cones which is a Mensuration, bring something in context. Bring about a child building up their own room. They want to paint the area. They want a perimeter of that room. They want um to tile up the things. Then that makes volume, perimeter and area. So, that will bring about the mensuration which look Latin to them or sound Latin to them. To the reality, *aam, is what we do. Traditionally we have these huts. They are normally either square, or cylinders. But in the end you put on this traditional hut itself. Where you thatch ne, if you look at it, it is more of a cone. Then, I always tell them, look around. Everywhere we look is mathematics.*

Ms Botham appear to suggest that students are expected to reconstruct the situation of building of huts under the gaze of school geometry. That is, building of huts have to be interpreted in terms of school geometry by using a shape of a cone. She suggests these traditional activities of erecting these huts should be subjected to mathematics principles and be described in mathematical terms.

Mathematics conical shape	**Shapes of Traditional huts**		
	***Ovahimba huts***		
			
	Ovawambo huts		
			

Though examples like these might help students to idealise mathematical concepts, there may be a possibility for students to develop false conceptions with regard to the intended meaning of conical shape. This could happen if the teacher does not make her rhetoric language used in teaching of mathematics concepts explicit to the student. For example, taking a closer look at the huts in the picture, not all huts that Ms Botham refers to have a proper shape of a cone. Some of these roofing are ‘more of’ a cone in their shape (their shapes are ‘closer’ to a cone shape). The pictures in the table above help explain this possibility. These picures were downloaded from the internet and the reference source is indicated at the the end of this appendix.

In recruiting this type of example while teaching mathematic concepts, careful attention needs to be taken in teacher use of metaphors, metonyms and similes (as rhetorical mathematics language). Presmeg (1997) maintained that teachers use analogies such as metaphors, metonyms and similes to give meaning to mathematical structures. Presmeg maintained that the *metaphor* can be considered as a implicit form of analogy, while *similes can be considered* an explicit form (Presmeg, 1998). Though *similes could be considered* as an explicit form of analogy, they might not constitute an explicit form of pedagogy. If a teacher relies on the recontextulising principle and makes an utterance like: Look at that Ovawambo hut, "*if you look at it, it is more of a cone",* this utterance alone might not do much to a student, more especially if she has never seen a concrete cone but just in pictures. Definitely, the learner might need further clarification on how the two differ and relate. The use of 'more of' in Ms Botham utterance can be considered as a simile. By simile, I am referring to an expression that compares one thing to the other, and it normally uses words such as *is*, *like* and so on. By metaphors, I am referring to "the application of name or descriptive term to an object to which it is not literally applicable" (Presmeg, 1998, p. 27).

Proposed example that suggests an advance mathematics application

Mrs Walter suggested that teaching students mere computations without involving the application of the concepts used might disadvantage learners. In Section 5.1.1, Mrs Walter proposed how the theme of Linear Programming could be applied. Mrs Walter's example could be taken as suggesting modelling of real-life activities. This also suggests the move towards the myth of reference. This is because in the setting of task contexts, the more the teacher is moving from everyday knowledge towards a generalised or strongly classified mathematics the more he seems to move towards a *myth of reference*. Dowling (1998) maintained that the myth of reference is distributed through problem settings that are constructed mathematically and retain only a trace element of non-mathematics significations. Linear programming problems are typical example of what Dowling is referring to. Linear programming is a special case of mathematics programming and a method that is used to determine the best outcome from a mathematics model. This teacher's remark indeed points to a myth of reference. Although the Advisor did not give a mathematics expression of linear programming, his utterance points to the mathematician of a business activity that is recontextualised and described in mathematics terms in order to get insight as to how much profit one could make.

Interner resource from which these pictures are taken is:

https://www.google.com.na/search?site=imghp&tbm=isch&source=hp&biw=1366&bih=667&q=himba+houses&oq=himba+hous&gs_l=img.1.0.0i24.2857.15783.0.18425.10.10.0.0.0.0.430.3913.3-7j3.10.0....0...1.1.64.img..0.10.3909...0j0i30j0i8i30.GQvVmxAnxec

Appendix 9: Reasons why some teachers do not consider the declamatory statement

Several factors emerged as to why teachers do not pay much attention or not at all to the curriculum declamatory statement mentioned above. The next discussion is based on these factors.

Teacher preferences over some syllabus' components

Some of those who do not read the statement appeared to do so by choice. Some knew the existence of the statement but choose other things over it. Mrs Martin admitted that she only goes to the theme that she has to teach:

> *Honestly, I didn't read it. To tell the truth, I didn't read it. I always just go to the theme which is there. The theme that I'm going to teach, that is all*.

Similarly, Mr Getrud echoed:

Mr Getrud*: We don't really concentrate or read this part. To tell you honestly, we only read what it requires from us to do.*
I*: What is it that they require?*
Mr Getrud*: The basic competencies are what you should learn, but this part, seriously I don't read it.*

The tendency not to regard this statement appeared to be a common trend as another teacher, Mr Pandu resonated:

I do not pay attention to the first pages. I only pay attention to the second part. That's the competencies, the themes and the other things

A similar claim was said earlier by **Mr Getrud**, who appeared confident and even more convinced that nobody reads such statements.

Lack of interest as reading the statement is constituted as a problem

Reading the declamatory statement is considered problematic by some teachers. In particular, Mrs Martin shared how reading the statement constitutes a problem for her:

There is a time when you want to do the things. A time like, instead of setting up a lesson planning or you plan your things and then you have got another of reading back to the beginning of the syllabus. Then I think that one is also, is a problem I think to me.

Weight of the Syllabus, exam-orientated system, and administrative pressure

Administrative issues such as teacher overloading, the demand to cover the syllabus, as well as an exam-orientated system also featured as contributing reasons.

Highlighting how exam-orientated system contributes, Ms Helao narrated:

I think it's not possible. I just teach based on-- I read the competence in the syllabus and then I will try to focus on that. Because then at the end it's about me finishing the syllabus. I have to teach what is there in the syllabus because at the end when they are asking about – when they are going to setup the exam they are not going to ask about the linkage of the situation, they are going ask what is required from the learners to know. So that's why sometimes you see that sometimes teachers do not link to the situation as such, even though it's necessary to link it for the learner to understand.

Some teachers felt that bridging mathematics and the everyday might not always be possible. This is one of the reasons that could hinder teachers to pay attention to the statement, if that is necessary. This response suggests that teachers make choices on what they think are relevant and what the circumstance demands. For example, Ms Helao appear to separate what she deemed as necessary 'knowledge' from establishing 'linkages'. For her it appears as if it means that 'making links' between the mathematics and the everyday is not considered as a component of the students' competence. Passing examinations is only what appears to be important. This according to her, she inferred from how the system works. The other important question one could ask is whether teachers see bridging mathematics and the everyday as a means or as an end it itself. It appears as if Ms Helao only sees this as an end but not as a means in itself. More extension on this is found in the discussion chapter.

There are many reasons why people teach mathematics and securing a good grade may be one of them. It appears that what matters most for this teacher is to complete the syllabus before exams start. First it seems like this teacher talks about herself only, but then she says 'teachers', in which she includes herself in the 'we'. Identity issues seem appear in this teacher's articulation. This teacher appears to create a divide between herself as a mathematics teacher, curriculum designers, as well as examiners. There appear to be conflicts of interest between these three different groups that need to be compromised. Curriculum designers ensure that they include all the aspects that are deemed necessary for the student's mathematics education. Examiners need the syllabus to be completed before examination starts, teachers have to ensure that this is done despite other commitments. The sort of compromise referred to is evident in the next excerpt. Ms Helao further reasoned:

> *Most of the time we do not do that because we focus on finishing the syllabus, and I think the syllabus is just too much to always try to divide every topic or always try to link it real-life situations. So most of the time we just focus on the learning objectives and basic competence in the syllabus and the finishing of the syllabus because at the end as I said they will set up the exams based on things that are in the syllabus*.

From this quote one cannot only sense the pressure from administrative tasks and the options teachers appears to take, but one can also see how teachers do not see the introductory part of the syllabus as part of the prominent component of the syllabus. It seems as if though 'making links' is considered as an important component in teaching and learning school mathematics, Ms Helao feels its prominence is not backed up by examinations and assessment criteria. Concerning the weight of the syllabus, Mr Kafula narrates:

> *Like nowadays our syllabus is too much and they want teachers to cover the syllabus. That's why sometimes you want to give them a lot of work to do but because of the time they won't even manage to finish, but we only give them a piece. Like nowadays we have learners from different places. Some are from rural areas. Some are from urban areas. So, therefore sometimes as teachers we only use the syllabus because of the examination they are waiting to write. But in reality, if this was looked properly, so this can be given enough time like Junior Secondary school phase.*

In addition, managing learners from different backgrounds also appeared to be a concern for Mr Kafula.

Time and other factors

For some teachers, time is considered as a main constraint. At some point Mrs Martin felt that maybe if she took the time to read the statement, '*it was going to be a wasting of time*'.

Maybe, I might say maybe it's because of the time*. Saying that maybe if I go to read that one maybe it is wasting of time. Let me just go straight to what is very important for the learners. Maybe it's how I have taken it.*

Evident from Mrs Martin utterance are further reasons as to why teachers do not pay attention to the curricular declamatory statement. Mrs Martin felt like maybe that is not important. She considers doing that as possibly a waste of time, and probably that the idea is not necessary for the topic a teacher is to present at a time. She also mentioned that she wanted to be told whether that statement matters. A similar remark came from Mrs Enkali who said they are not informed:

> *Um, we are not informed. For use we only found this curriculum already there. For you it's just to follow it.*

Apart from the above mentioned reasons, Mr Getrud thought it is probably not necessary.

> *Maybe it's not necessary for me, because I only deal with the chapters that are in the syllabus and the basic competencies then I plan my lesson.*

Others are of the opinion that they were not encouraged or trained as teachers to engage with this type of statements:

> *Well, it could be that maybe when we were trained as teachers we are not really encouraged on-we were not encouraged to pay attention to that page.*

Some teachers attribute this to the lack of continuous professional development. They claimed that they never get chance to attend teacher workshops:

> *No. We don't. We hardly get workshops. Let me say from advisory teachers. And I think ever since I came to this school I never attended a workshop for maths. Never.*

In some cases, Mrs Martin speculated that it could be due to lack of interest.

Maybe I might say uff, I'm not maybe interesting, I don't know, I cannot give you the really reason what's the meaning why I'm not- I didn't read the whole things.

Mrs Martin attributes it to lack of understanding:

It could be maybe because um-- To tell you the truth I don't understand the meaning of that statement.

Mr Getrud speculated that language barrier might have played a role:

May be it's the English. Can you put it in simple English? The thing is I don't understand that statement. I don't know how to answer that statement. That's why I'm just trying my very level best to answer it.

In summary, the main reasons discussed above are time factor, not sure of its necessity and importance, lack of training, encouragement, information and chance to attend teachers workshops, syllabus weight and administrative pressure, lack of understanding and of interest, never told, and doubting whether that statement is necessary for the topic to be taught.

Appendix 10: Ethical approval from Namibia

REPUBLIC OF NAMIBIA

MINISTRY OF EDUCATION

Tel: 264 61 2933200 /
Fax: 264 61 2933922
E-mail: mshimho@mec.gov.na
Enquiries: MN Shimhopileni

Private Bag 13186
Windhoek
NAMIBIA

3 April 2012

File: 11/1/1

Mrs Frieda N Vatileni
263B Holmesdale Road
South Norwood
London SE25 6FR
UNITED KINGDOM

RE: REQUEST FOR PERMISSION TO CONDUCT A RESEARCH STUDY AT SOME SCHOOLS IN OSHANA REGION

Your letter dated 21 March 2012, seeking permission to conduct a research at some schools in Oshana Region, has reference.

Kindly be informed that the Ministry does not have any objection, in principle, to your request to conduct a research at the identified schools.

You are kindly advised to contact the Regional Council Office, Directorate of Education, for authorization to go into the schools as they are the immediate custodian of the schools.

Also take note that your research activities should not interfere with the normal school programmes, being from your side or the schools you intend to visit. Participation by teachers in the interview should be on a voluntary basis.

It will be highly appreciated if you would share your research findings with the Ministry.

By copy of this letter the Regional Director is made aware of your request.

MINISTRY OF EDUCATION
PRIVATE BAG 13186
WINDHOEK
05 APR 2012
PROGRAMMES AND
QUALITY ASSURANCE

Yours faithfully

A. Ilukena
PERMANENT SECRETARY
cc: Director: Oshana Education Directorate

Appendix 11: Grade 8 lesson on perimeter

Didac. function	TIME	Teacher-learner interaction	REMARKS
Revision	0000	**T**: Iyaa, it is almost time people. Ok. Fine. Last time was um about ( ). The second one was on area converting kilometres to metres. The third one was also on area. The fourth one was about um volume. And the last one was about the capacity and I will explain to you later. Ok fine people the lesson for today is, we are going to do mensuration. *[Writes on the chalkboard]* Ok. For those who are copying the solution please hurry up hurry up. [*pause*] Hurry up please. Please hurry up. You are not yet done? [pause]	**Episode** 1 Teacher discusses homework solutions Domain: esoteric
Introducing/developing/Sharing knew knowledge	0400	**T** (proceeds)**:** Iyaa. So, today we are going to look at the perimeter. Look at the perimeter. Who knows what a perimeter is.	**Episode** 2 **Topic**: Perimeter **Theme 1**: Defining the perimeter **Domain**: Expressive because a non-mathematics expression is drawn in to explain mathematics structures. Perimeter is a line which forms up a boundary. Or is a distance around the object **Interaction**: Tac
		Ss: [silence]	
		T: What is a perimeter? Mh.	
		Kaino: It is a distance around the shape?	
	0500	**T**: It is a distance around the shape. What about you? What do you say? Mm? He said it is a distance around the shape.	
		Ben: *[silence][pause]*	
		T: That is the statement. Or someone can say. The perimeter… the perimeter is the line that em. Iyah. As I said in the previous lesson that people measurement is very… very important. It is	

		playing a major role. Ee?	
		Ss: Mm	
		T: Now…I said the perimeter is a line which forms up a boundary. Or is a distance around the object… isn't?	
		Ss:Yes	
		T: Ok. Let me ask you before I go further. What do you think is the perimeter of the school?	**Theme 2**: Defining the perimeter of the school **Domain**: Public - expressive - Started with Public domain because of weak institutionalisation in terms of content and expression. Expressive because a non-mathematics expression is drawn in to explain mathematics structures = You have to refer to the-fence of the school **Interaction**: Tac
		Ss: [silence]	
		T: Ee?	
		Ss: [silence]	
		T: Mm?	
		Tom: The perimeter of the schoola [sic]?	
		T: Ee. Is what? Ee?	
		Tom: Five per cent.	
		T: Wowowowo. I did not ask you to calculate anything. I said that – what I want you to understand and to know is this? Perimeter. Ee?	
		Saima: A perimeter okudjaapa toyingahafiyo o papa. (A perimeter is going this way starting from here up to here) [Saima talks to her seatmate].	
		T: So we said the perimeter is **a distance around** the?	
		Ss: Object	
		T: Object or the?	
		Ss: (( ))	
		T: Which means now if we are talking about the perimeter of the school we are talking about the?	
		Sem: Measuring the distance of the-	
		T: Of the what? Of the?	

		Ss: Fence	Teacher rely on expressive
		T: Fence of the school. You have to refer to the-fence of the school. Are we together?	
		Ss: Yes	
		T: Ee?	
		Ss: Yes	
		T: Ok. What is the perimeter of your house?	**Theme 3**: Defining the perimeter of the house
		Ss: Perimeter?	**Domain**: Public - expressive
		T: Ee? (( )) Ee?	
		Ss: [silence]	Started with Public domain because of weak institutionalisation in terms of content and expression. Expressive because a non-mathematics expression is drawn in to explain mathematics structures = the *perimeter* of the school is that *fence* which divide the school from the other side
		T: **If** the perimeter of the school is that fence which divide the school from the other side… can you see now?	
		Ss:Yes	
		T: Ee?	
		Ss:Yes	
		T: Which means now that-- that **fence if you cross it then um owa ya monhele yamukweni hasho**? (Which means, that fence if you cross it then you are in somebody's place/territory, isn't?) Ee?	**Interaction**: Tac
		Ss: Yes	Here the teacher relied on the expressive domain again
		T: Ee?	
		Ss: Yes.	
	0655	**T**: Now… what do we call the perimeter of your house?	
		Heita: *Sticks*	
		T: Ee?	
		Heita: Sticks	
		T: Sticks?	

		Heita: Yes	
		T: Of the house?	
		Heita: Yes	
		Lukas: The building.	
		T: The building?	
		Lukas: Yes	
		T: Now is when you are at the rural areas or at the urban areas? In towns or in rural areas?	
		Lukas: In towns	
		T: In towns	
		Lukas: Yes	
		T: So you mean the building is the perimeter?	
		Likas: Silence	
		T: Osho wa hala kutya?	
		Lukas: mm	
		T: Ee?	
		Nera: It is true	
		Ben: Oh	
		T: Ee?	
		Sara: is a wall	
	0816	**T**: Ee?	
		Sara: It's a wall	
		T: Is a what?	
		Sara: A wall	
		T: A wall? Ok.	
		Setson: a wall is a ((building))	

		T: Aa a. (No… no). Building and a wall? Now she is referring to the wall that separates their plota [sic] from the neighbour's plot. Are we together? So people it is always necessary to do what? Ee? To know how to find a perimeter. Hasho (isn't?)	
		Ss: Yes	
		T: Nowadays oha tu udu ovanhu ta vaningi shike- ta va pula Omalenga, va ti omhunu a kufa ko onhele yamukwao, hasho? (*Nowadays we hear people asking Headmen that somebody took my piece of land… isn't?)*	**Theme 4**: Taking unnecessary piece of land. **Domain**: Public Public domain because of weak institutionalisation in terms of content and expression. **Interaction**: story telling This section signposts a *myth of emancipation* via storytelling but no calculation is made yet.
		Ss: Ee (yes)	
		T: Ee?	
		Ss: Ee (yes)	
		T: Aaye mukwetu o wa ya kokule unene. Ehena ngoo langhele oku. Ee? That is the perimeter that divides the plot from the neighbour's place. Are we together?	
	0900	**Ss**: Yes	
		T: That is why it is very important to know measurement and to know how to calculate the-Perimeter.	
		Ss: Perimeter.	
		T: But when it comes to the *shapes* we use *numbers*. We use numbers. Traditionally we only use what? We only calculate the ((feet)), hasho? (Isn't?).	**Theme 5**: This is a public domain, however the teacher makes an attempt to move from public to esoteric domain but still remained in the public pedagogic mode of action. Public domain because of weak institutionalisation in terms of content and expression. Few mathematics terminologies are recruited such as shapes, numbers, dividing but shapes and numbers are not discussed at this
		Kema: Yes	
		T: Hatu ti apa naapenya naakwinya… yah… onhele yoye oyo yo. Operimeter. Omunhu ngeenge ta tendelwa epya laye. Ee? *(We say from here and there and there and up to there. That is your place. The perimeter. That is how somebody's piece of land is measured, isn't?).*	
		Ss: Ee	

		T: Ngaashi nee vamwe okwa li ha ku tiwa kutya- You know long time ago… yah from here… just decide where to end. Omunhu oto ha nge nee a kufako nee onhele ihapu ya kula. Like it is also happening to the what? I think this side of- Uukwambi. Hamutenyawa Ndahafa's place. *(Just like for some people… long ago… they use to say start from here decide for yourself where to end. You would find that a person has taken a large piece of land. Like it is also happening to the what? I think this side of Uukwambi area, at Hamutenyawa Ndahafa's place)*	point.
		Ss: Yes	
		T: A very big place. But now people are busy *dividing* it into farms again.	
		Soini: Oh	
		T: Yes. Because they own- they take out the big place. O pena ovanhu vamweve li selfisha. Otokufako nee onhele i fike op ongahelipi? Oove auke? (*Yes. Because they own- they take out the big place. Some people are selfish. How can they take such a big piece of land? Are you the only one?)*What about others? How will they survive? (( )) You see. You must take what is enough for you. Some are just taking the big place but they are not using it. O u na ashike omupya wandja apa fiyo o kOmufiya kwinya, ile kOndagwa ngoo. Ove o u naeengobe di li nhano. (*You just have a huge piece of land from Omufiya or even from Ondangwa and you have only five cows.)*	
		Ss:[*Laughter*]	
		T: Eee. noikomboi li omilomgo ne. I li omhilongombalikutya. Ee? Oto dulu ngoo okulonga po apeshe opo? *(Yes, and forty goats, I mean twenty. Yes? Are you able to work on that huge piece of land?)*	

		Tauno: Ee (yes)	
		T: Yaah... people… make sure that when you are taking a place of your own… leave for others please. Do not be selfish yee? To kufakongoo she kuwanaovetofiilepomukweniyee. Nandeota mu kongaakongangoonandeomapyakomifiyakwii… otokufakongooonheleyoyeyekuwana. *(Yaah... people… make sure that when you are taking a place of your own… leave for others please. Do not be selfish, ok? Just take what is enough for you and you leave some for others. Even when you go to Omufiya to look for a piece of land, you have to take what is enough for you.)*	
		Ss: Ee	
		T: To kufako ngoo eemeta donhumba… to valula… you measure it and make sure that it is enough for you. Don't just take everything. *(Just take a certain number of metres, count them... measure them and make sure that it is enough for you. Don't just take everything.)*	
	1110	**T (***proceeds***)**: Fine. What about the shape? How do we calculate the perimeter? People whenever we are calculating the perimeters then we have to add the sides. [*pause*] Ee? [*pause*] how do we calculate the perimeter. It is when we add the sides together. Very good. But remember as I said. The *perimeter is a distance around the objec*t.	**Episode** 3 **Topic**: Calculating the perimeter of shapes **Theme** 1: Copying from chalkboard **Domain**: relied on expressive first them move to Esoteric **Interaction**: Tp, Sc,
		Ss: Object	
		T: Therefore now we are going to look to- on how to calculate the perimeter of different shapes. Ok. I think you are done with this one?	

		Ss: Yes	
	1220	**T**: Ok copy now. [*pause*]This is what? Mm? Be serious	
		Ss: [*laughter*]	
		T:[*pause*]*Teacher writes notes on the chalkboard.*	
		Ss:*[Students whisper among themselves]*	
	1542	**T**: Can I clean this side?	
		Ss: Yes	
		T: Ok. Fine any question before we start? Anything you do not understand? Any problem?	
		Ss:No	Teacher crack a joke
		T: Any Malaria?	
		Ss:No	
		T: Ok. Fine. [*pause*]	
		Ss: *[Students whisper among themselves]*	
		T: [*teacher continues to write on the chalkboard*]	
		Ss: *[Students whisper among themselves talking about soccer tournament among various schools]*	
	1830	**T**: Ok. Very good. [P*ause* as *teacher continues to write on the chalkboard*] Ok. Fine people. We have to pay attention to the chalkboard. Pay attention. May I have your attention please?	**Theme** 2: Listing names of quadrilateral shapes **Domain**: Esoteric - naming and discussing maths shapes **Interaction**: Tac
		Ss: Yes	
		T: Ok we have four different shapes or three shapes on the chalkboard.	
		Ss: Yes	
		T: What is the name of the first one?	
		Ss: A Triangle	
		T: A Triangle. The second one?	

		Sos: Square… rectangle.	
		T: It is a Square or a rectangle?	
		Ss:Rectangle	
		T: A rectangle. The third one?	
		Ss:Rombus	
		T: Ee?	
		Ss: a Rhombus	
		T: Rhombusa [sic]	
		Ss: [laughter]	
		T: It is a?	
		Ss: Parallelogram	
		T: It is not a rhombus but it is a?	
		Ss: a parallelogram.	
		T: The fourth one?	
		Ss: Square	
		T: Square. Fine. Now we know the names of these shapes.	
Practice and assessment	1950	**T (proceeds)**: Can we start calculating the perimeter of these shapes?	**Theme 2**: Calculating the perimeter of shapes (classwork by students) **Domain**: Esoteric **Interaction**: Wi,
		Ss:Yes	
		T: I said the perimeter is a distance around what?	
		Ss: Shape	
		T: Ok. Can you do that one for me now?	
		Simon: Yes	
	2010	**T**: Hurry up… hurry up… hurry up. [*pause*] Time. The time is limited. Draw the shape then you calculate the perimeter. I will only give you maybe how many minutes before I start marking the first one?	

		Sos: Five minutes… seven	
		T: Ok. Five minutes. Seven... ah that is too much.	
		Sem: Eight	
	2020	**T**: Prove to me that you understand that statement. [*pause*] Aaaa. Individual work. Individual work. Individual work. Individual work. It is an Individual work. You are done?	
		Mark: Yes	
		T: [*pause as the teacher begun to mark student's classwork*]	**Theme** 3: Calculating the perimeter of shapes by the teacher (feedback) **Domain**: Esoteric **Interaction**: Wi,
		Ss: Sir... Sir. sir	
		T: [*continues to mark student work*] Yah… can I stop marking?	
		Sos: Yes… No… Yes… No	
		T: So Tauno…Are you done?	
		Tauno: [silence]	
		T: Tauno Haikali… you said you are done?	
		Tauno: The first one.	
		T: The first one?	
		Tauno: Yes	
		T: The first one is fine. Go on with the second one?	
		Ss:[*pauseand students talk among themselves*]	
		T: The first one then you move to the forth one.	
		Ss:[laughter] the easy ones.	
		T: Ee? The easy one? A a (no)	
		Ss:Yes	
		T: Do the first one, the second, the third and so on.	

		Ss: Yes Sir	
		T: Sheni drew the shapes. Very nice shapes. And makes sure people that you draw with a? Where you not given parcels? [teacher refers to a maths set]	
		Ss: We were.	
	2400	**T**: Where are those parcels?	
		Ss: Home	
		T: you must start coming with your parcels. If you lost it them um-	
		Ss: You will be ((punished)).	
		T: I said the distance around the shape. [*pause*] You can only make it if you understand that statement. [*pause*] Tell me if you are done with number one.	
		Ss:Ok [*pause*]	
		T: you must use something to cover your work. Otherwise somebody will um- [*pause*] Hey…you must draw a very nice thing. Is this the first one? Is this a rhombus or what? Mm?	
		Ss: [Silence]	
		T: Make sure when you are drawing a shape you must use a ruler.	
		Ss: [*pause*]	
		T: This one?	
		Ss: [*pause*]	
		T: Where are you?	
		S:here	

		T: Very important. Let me start from the back. I will come back to you. Um only one?	
		Tim: Yes	
	2600	**T**: Ok. Fine. You are fine.	
		Ss: [*silence*]	
		T: The third one? Ehe... go on with the fourth one. Go on with the	
		Tom: Second one	
		T: Second one?	
		Tom:Yes	
		T: Go on with the-	
		Sela: First one	
		T: Only the first one?	
		Sela:Yes	
		T:Aa… I said the shape around the- I mean the distance around the object. Is this one outside or inside?	
		Ss: (( ))	
		T: Around	
		Ss: Sir… sir	
		T: No nono. Do not warry. I will come back.	
		Ss: [noise]	
		T: That is not for that shape. it is not for that shape.	
		Shetu:Heeno shapo.	
		T: Ok. Um (0.3) this table?	
		Ss: [noise]	
	2800	**T**: Sorry… sory. Do not make noise please. Others are busy doing their work. Don't give trouble to others… please. I said a distance around the shape.	

		Kemanya: Sir [*pause*]	
		T: Eee? Mm? I said whatever you are drawing people... haa? Use a pencil. Some are just drawing like a snake (( )). (0.3) Make sure when you do not understand you must ask. I said the distance around the object. You move around… not inside. You said the perimeter of your house is a wall… isn't?	
		Sara: Yes	
		T: Ee? If I say move around the perimeter of your house… will you move around the wall again and again inside the rooms? Ee?	
		Sara: No	
		T: [pause]	
		Ss:Siiirrrr	
		T: I am coming.	
		Ss: [noise]	
		T: Aaaye. Aa… a. If you are done… if you are done do not disturb others.if you are done do not disturb others. If (( )) don't (( )) the person.	
		Kema: Number three.	
		T: Because I want to know those who do not understand. You can only get it correct if you understand the statement. [pause]](( )).	
		Ss: Yes	
	3000	**T**:[*pause*]	
		Ss: [noise… student talk among themselves]. Sir [*pause*]	
	3232	**T**: Iyaa let me check if you are done.	
		Ss: [*pause*]	
		T: Iyaa I will be coming starting from the back please.	
		Ss: [*pause*]	

		T: ok. Let me check this. You must always indicate your (( )). You must alsways indicate you are calculating. [pause]I can't believe this one.	
		Nangula: (( ))	
	3340	**T**: Mm m mh. People… as I said that when you are drawing a shape… don't just draw as long as you draw. Mmm? Ito fanekeashikengaashieyoka ta li endekaya. (You just don't draw like a snake alithering.) There must be a difference between a snake and?	
		Ss: an object.	
		T: An object. Because if you change the shape it means that um the name of the shape will also change.	
		Ss: [*pause*]	
		T: I did not mark any work of yours. This is number what?	
		Kaino: Two	
		T: This is number two.	
		Eila:Ame o ha ndiningi number four. (*I am doing number four*).	
		T: [*pause*] A!… are you done already? Are you done already?	
		Helao: Yes	
		T: Are you sure?	
		Helao: mm	
	3500	**T**: [*pause*]. Hey hurry up. Hurry up my boys. Don't ask Salatiel.	
		Ss: [*talk among themselves*]	
		T: I said the distance around the object. Mm?	
		Ss: [*talk among themselves*]	
		T: Units… units.mm? Twenty-six what? Twenty?	
		Ss: [*talk among themselves*] Sir?	
		T: My boys… can I mark your work? Mm? Can I mark your work?	

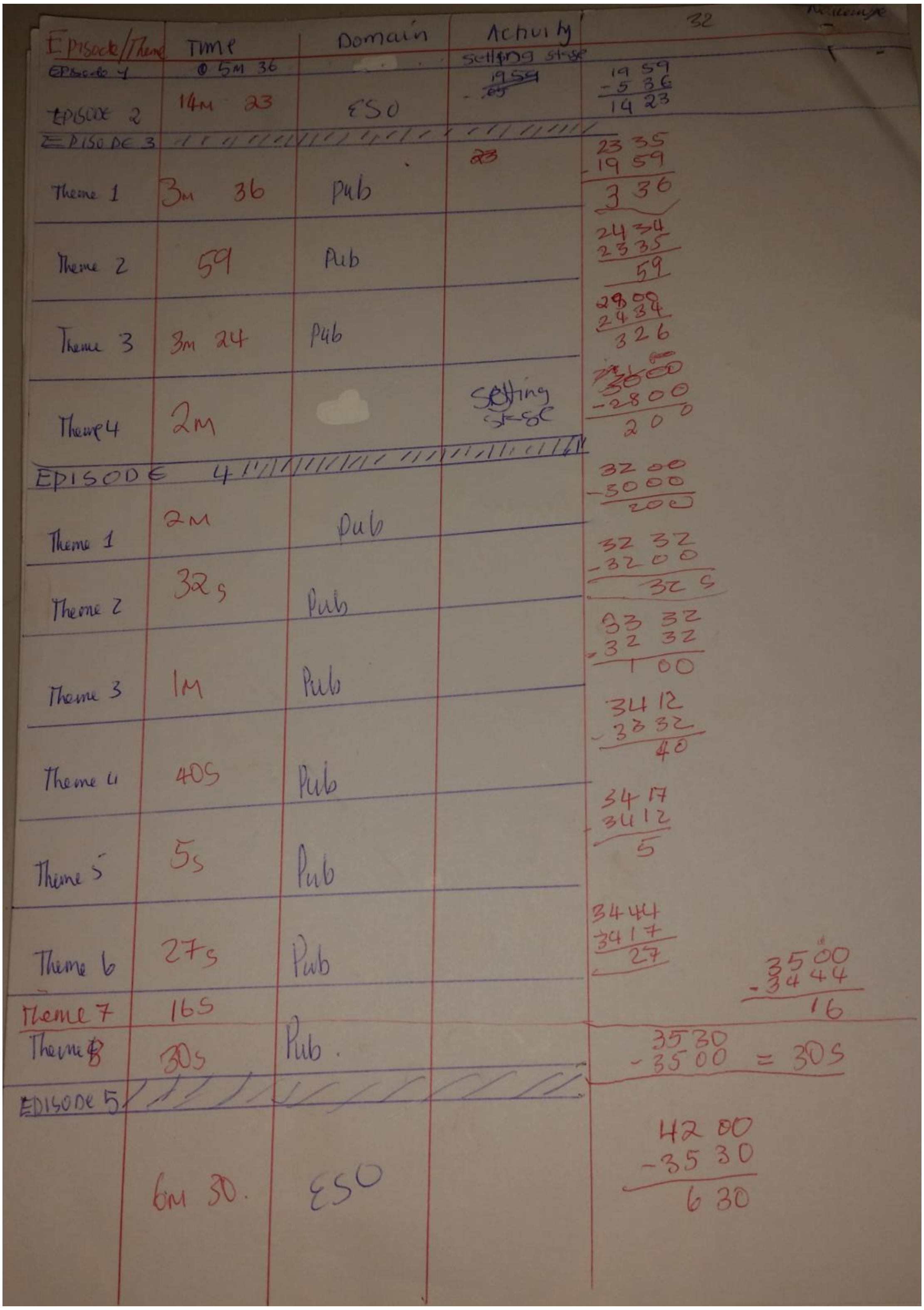
		Ss: [*talk among themselves*]	
		T: Wo… wo… wo... wo. I didn't mark your work.	
		Ss: [*talk among themselves*]	
		T: This is nice ee?	
		Ss: [*talk among themselves*]	
		T: I said perimeter is a distance around the object. And we out those ones together. Ee? We add the sides together. We do not multiply by two.	
		Ss: [*talk among themselves*]	
		T: distance around the shape. From here to here to here… not inside.	
		Ss: [*talk among themselves*]	
		T: (()) hasho? Fiyo o pa pa. (Up to here... isn't?)	
		Ss: [*talk among themselves*]	
		T: Ok.Yah… next is you as well. Eee?	
		Ss:[*talk among themselves*]	
		T: For the first time.	
		Mauno: O	
		T: Yes. It is for the first time I check.	
		Ss: [laughter]	
		T: You must start playing soccer may be.	
		Ss: [laughter]	
	3800	**T**: I say- Sorry people. Wo… wo… wo… wo. There is a problem here. I said the perimeter is a distance around- you add the sides.	
		Ss: [talk among themselves]	
		T: Now (( )). Did you cover the whole shape? Aa? You must cover the whole shape. Aroung the shape. Mm? Not half. Ok. Is it	

		clear now?	
		Mauno: No	
		T: Yes my boys? Are you progressing?	
		Ss:[silence]	
		T: Ee?	
		Ss: [*talk among themselves*]	
	3908	**T**: Yah people… the only (( )) from these school boys.	
		Benson: (( ))	
		T: Yah you are not yet done.	
		Heiat: (( ))	
		T: Mm?	
		Ss: [*talk among themselves*]	
		T: I said if you change- wo… wo… wo. Problems. Yah… listen now. Look here people. I said make sure when you are drawing… like this one here. This means if I put one here it means they are?	
		Ss: Equal	
		T: Now what about this one? He draw a very nice drawing like this mm? If you draw a shape like this… this is no longer a parallelogram but it's like a?	
	4017	**Bell rings**	
		Ss: trapezium.	
		T: Trapezium. This is different from this one. This is not a trapezium. Do you understand?	
		Ss:Yes	
		T: That is why I am saying please try to draw a shape as it is .How far are you now?	
		Ss: [silence]	

		T: Ee?	
		Ss: [*talk among themselves*]	
		T: [pause]	
		Ss: [*talk among themselves*]	
	4100	**T**: Ok. Who will help me to assist this boy?	
		Sacky: Herman	
		T: Ok. Herman… you must assist him when we go to the class ne?	
		Herman: Yes Sir	
		T: And the other one again?	
		Ss: Aaye (no). [*talk among themselves*]	
		Maria: I will help him. I will help you	
		T: It is time.	
	4140	**Ss**: [*talk among themselves*]	
		T: ( )	
		Sem: Can you get this?	
	4144	**The end**	

Appendix 12: Estimate time taken per domain

In this appendix, I intend to highlight examplars of how the estimate time per domain was determined.



NAKAMWE

ESO	EXPr	DESC	Pub	Pub+mov	Pub+No move
14M 23			3M 36		
6M 30			59		
20 53			3M 24		
			~~2M~~		
			2m		
			~~32~~ 5 32		
			1M		
			40 s		
			5		
			27		
			16		
			30		
			9M 26s		
			4 29		
20 53			13M 29s		
13 29					
7 36					
41 58					

SD
~~3M 10S~~
5M 36
2M
7m 36